POWER

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ELY C. HUTCHINSON, *Editor*

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Audi Alteram Partem

ONE of our friends admonishes me that the forewords on "Courtesy to Salesmen" and "The Bullyragging Buyer," in the June 17 and 24 numbers, respectively, did not meet with his full approval.

He had been listening to "one of the loud-mouthed variety of salesmen" working upon another buyer in his office and is firmly convinced that I went in only one direction with my criticism.

I am reminded of a story that George Babbitt of the William A. Harris Steam Engine Company used to tell on himself.

He spent his week-ends in Connecticut and used to stop off occasionally on his way back to Providence to try to convince the owner of a factory along the road how much more life would mean to him if he owned a Harris-Corliss engine.

Persistency, persuasion, and a good case finally won. But the customer, after signing the order, unlocked a case and took out a box containing a beautifully polished appliance carefully done up in tissue paper.

This he turned over to Mr. Babbitt "in trust," charging him that if he ever met anybody who could do a more persistent job of talking than he had done, it was to be turned over to him.

Babbitt took it along, put it on top of a cabinet in the office and forgot it.

Two or three years afterward a breezy salesman with a strident voice called and wanted to unload some emery products. He was told politely that they were not in need of anything in that line; but he had his piece committed and had to speak it.

From his private office Mr. Harris looked annoyed and slammed the door. Another executive poked his head up over his roller-top desk and waved signals of distress. The office force was in a confusion of amused disturbance.

After several vain attempts to shut off the racket Mr. Babbitt arose and said, "As I have told you several times, we are not in need of any emery at present—but I have something that belongs to you." And blowing the dust off the package he undid the nickeled implement and presented it to his visitor.

In reply to the recipient's look of questioning astonishment he explained:

"I sold the man who made that tool an engine some years ago. It took many calls and a lot of argument to land him. When the deal was closed he handed it to me and told me that if I ever came across a man who could do a longer, louder, and more persistent job of talking than I had done I was to pass it on to him. It is yours. He was a manufacturer of undertaker's hardware and this is what they call a chin supporter."

F. R. Low

EDITORIALS

Will the Vertical Turbine Come Back?

MORE THAN any other power plant equipment, steam turbine designs have been developed, discarded, and redeveloped. Hero was the first to create the reaction turbine, and Branca the impulse type. But the turbine was then forgotten until after the steam engine had been developed. High-pressure turbines built in the time of Gustaf De Laval were discarded only to be redeveloped in the present era. Several of the earlier power plants bled steam from the turbines for feed-water heating, but here again the idea was dropped, and today it is practically a universal practice. Most of this abandonment of early turbine forms, and the subsequent redevelopment, was due to a lack of advancement in parallel machine design or mechanics. In other words, the original creation was ahead of its time.

Early central station turbines were vertical machines. They were rugged and possessed many desirable features, such as small floor space per kilowatt capacity, easy starting, etc. One of the difficulties, as sizes increased, which largely influenced the abandonment of this type in favor of the horizontal unit, was with the thrust bearing.

Since the time of the vertical unit the Kingsbury thrust bearing has been developed. This thrust bearing has given satisfactory service in vertical waterwheels under much heavier loads than the old step bearings were required to withstand. May not this mechanical development lead to the redevelopment of the vertical turbine to meet demands of greater capacity per unit of floor area?

Idle Machines Need Attention

UNLESS properly protected, deterioration may be more rapid when machines are out of service than when in regular operation. The insulation of electrical equipment, for example, requires even more attention during idle periods than when in use. When running, the winding temperatures are such as to keep out moisture. During idle periods machines do not have this natural protection and, where necessary, must be provided with a substitute.

Insulation-resistance tests show the engineer what he needs most to know about the condition of electrical machines. If they are to be shut down for some time a test made with a megohm meter will show the condition of the insulation. This should be followed by a thorough cleaning and drying and a good coat of insulation varnish to keep out the moisture. After that, periodic tests will show how closely the insulation is retaining its original quality. If rapid deterioration sets in, it will be detected and can be corrected before serious damage is done. A little attention to idle equipment may prevent expensive repairs and delays when it is required to go into operation again.

Dividends of 33 Per Cent

AN ANNUAL SAVING of $250,000, by investing $750,000 in the power plant, is no small item, for it means a return of thirty-three per cent and an early retirement of the investment. How so large a saving was effected is told elsewhere in this number of *Power*.

The case in point is a paper-board mill with large but fluctuating demands for process steam. The power plant was no longer modern. The boilers operated at moderate pressure which varied considerably, owing to the fluctuating steam demand, and their aggregate capacity was insufficient to obtain maximum output from the mills. In the engine room one unit operated non-condensing to supply part of the process steam, the remainder of the process requirements being drawn from the boilers. The second unit operated condensing, so that it might generate more power, and about one-half the power load was purchased. Steam rates of these units were high, and the entire combination, naturally, was inefficient.

Increasing demand for the company products called for expansion. Careful analyses revealed the possibility

that over fifty per cent more board of better quality could be made with the existing paper machines by installing a new power plant.

In this new plant the power and process-steam demands were co-ordinated, and a constant balance maintained by use of an accumulator. An initial steam pressure of 650 pounds permitted of operation at back pressures of seventy and forty-four pounds, respectively, to fulfill process requirements without the use of live steam. It also made possible the selection of prime movers with a low water rate that would establish a balance at the extreme condition between power and process steam.

By absorbing surplus steam when the supply is in excess and giving it out when there is a deficiency, a constant balance is maintained by the accumulator, while the boiler operates at practically constant load.

Summarizing, highly efficient modern equipment replaced inefficient inadequate equipment. Condensing operation with its attendant losses was eliminated. The purchase of one-half the electrical demand was discontinued. The power and process-steam demands were co-ordinated to give an over-all thermal efficiency several times that possible with the old plant. Finally, with an accumulator to maintain the balance between steam demands and nearly constant operating conditions for the boilers, high economies were maintained.

Savings in proportionate amount are possible in many industrial plants where the conditions are similar. Adoption of higher pressures, use of efficient equipment, close co-ordination between power and process demands, and the capital for the initial investment, are the requirements. Large dividends are assured those having the initiative to grasp the opportunity.

A Posthumous Award

ONE OF THE most interesting awards announced at the recent N.E.L.A. Convention in San Francisco, was that of the American Superpower Corporation in connection with the Bonbright Prize Essay Contest of 1925.

Many will recall the earlier contest, in which prizes aggregating ten thousand dollars were awarded for essays portraying progress in the electrical industry during the decade 1920 to 1930. The awards at that time were based upon the general excellence and scope of the papers, but the accuracy of the forecasts necessarily awaited the 1930 review, for which the American Superpower Corporation offered a single prize of ten thousand dollars to the paper "that shall appear to have most nearly approximated the facts as they eventuate." This latter prize went to Reuben B. Sleight, whose paper in the earlier contest received only minor recognition. Twelve of the fifteen judges comprising the board also served in the earlier contest, and the papers were judged without knowledge as to authorship.

The accuracy with which the winner predicted certain trends in the industry and the small deviation from actual 1929 data in a number of instances are remarkable. For instance, in 1925 when the popular conception of "superpower" was huge mine-mouth steam plants or remote hydro plants serving industrial sections through long high-tension transmission lines, Mr. Sleight clearly saw the solution in the interconnection of independent systems and the unification of districts in which the growth of the holding companies would play an important part. Considering that the total output of central stations in 1920 was slightly over twenty-nine billion kilowatt-hours, his prediction of ninety-two billion kilowatt-hours for 1929 is almost uncanny, for the actual output was within six-tenths of one per cent of that figure. He also saw the present trend toward high steam pressures.

It is most regrettable that Mr. Sleight did not live to witness this recognition of his work. While employed on some special work for the Department of Commerce he was killed in an airplane accident in 1927. Thus was cut short a career that might have held much for the electrical industry.

The Flue Dust Problem

THE problem of flue dust disposition, more than any other, seems to be engaging the attention of European engineers as well as American. Abroad it is so important that it is being studied on a national scale. Every known method is being tried and experience reports are being made upon bag collection, electrical precipitation, water washing, and other systems. Prominent European engineers express the opinion that the ultimate solution will be by some water-washing system.

One thing is certain: The genius who shall devise a simple, effective, inexpensively operated flue dust precipitator will earn the gratitude of the public and find a great demand for his wares the world over.

▼

POWER *Stands for . .*

1. **Making Power When It Should Be Made**
2. **Buying Power When It Should Be Bought**
3. **Cheaper Power Through Modern Equipment**
4. **Easier Financing of Equipment Purchases**
5. **Better Use of Byproduct Heat and Power**
6. **Operating Methods That Save Money**
7. **Less Waste in Transmission and Application**
8. **Prevention of Smoke, Within Reason**

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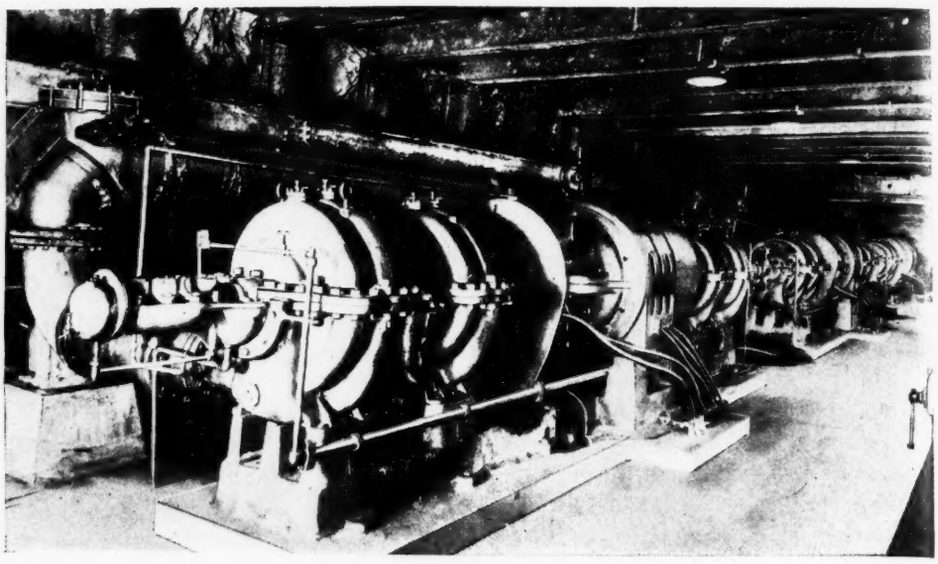

An underground automatic motor-driven pumping plant

SELECTION *and* OPERATION *of* Mine Pumping Plants—I

Shall the source of power for driving the pumps be steam, electric, air or hydraulic; shall the pumps be of the variable-volume type, have their speed adjusted or be stopped and started automatically to meet the pumping demands? How to overcome priming difficulties

By L. D. ANDERSON
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ENGINEERS engaged with the mechanical problems of mining are called upon at times to work out new installations for drainage and pumping. Although each installation may be a particular problem of its own, nevertheless some assistance in its solution may be found in a consideration of previous experiences.

The old steam pumping plants for mines, with their cumbersome piping, heat, and wasteful transmission of power, are largely giving way to electrically driven pumps. The transmission of power by electricity is so much more convenient and economical that for mining operations of any size or long duration it will be found preferable to install generating plants on the surface and transmit the power underground electrically.

Quite generally the utility company's transmission lines are close enough to permit of running branches to mining operations. If the operation is of a temporary character, or shallow, then it may be advisable to consider steam pumps. Anyone, however, who has maintained long steam lines to underground pumps and has later used electric pumps will not return again to steam if it can be avoided. Therefore, except for certain special conditions, it will be found that electric transmission of power to underground pumps is generally preferred.

There are conditions where compressed-air-driven pumps are used and justified. These use the primary power at such a low efficiency that they should be avoided when possible. It sometimes happens in mining that a sudden flow of water is struck where compressed air used for rock drills is the only source of power immediately available. Under such circumstances it is permissible to use air for pumping until other arrangements can be made. A relatively small flow of water may perhaps be taken care of more cheaply by a small compressed-air-driven pump than by a more efficient pump of other types. But if the flow is large or permanent, compressed-air power is seldom justified.

Hydraulic power can sometimes be used to advantage. There are cases where mines opened in the higher elevations of hills were later drained by adit tunnels below the original workings. Afterward the operations were continued below the tunnel level. When operating below the tunnel level, water continued to flow from the upper levels. The sinking operations were unwatered by using a simple jet ejector, actuated by water pressure obtained from the upper levels. This water, plus that picked up

by the ejector, finally flowed out of the mine through the adit or drainage tunnel. This method of lifting water is so cheap and simple that it deserves more attention than it has received. Although it is not mechanically efficient, where conditions are favorable it is economical. Sometimes it is even possible to obtain sufficient hydraulic pressure from water outside the mine to lift water from sinking operations.

Although electricity is the preferred form of power transmission, it may involve difficulties in obtaining variable speed and therefore variable capacity. While direct-current motors may have their speed readily adjusted, alternating current is more commonly used with power transmission. The simple squirrel-cage induction motor is a constant-speed machine. The flow of water in a mine can rarely be estimated closely. So it is generally necessary to install pumping equipment of excess capacity to take care of possible increase in flow resulting from extension of operations. This results in pumps which must be started and stopped frequently, making the load factor poor. It is difficult to provide storage space in which to accumulate water for a prolonged shutdown. Some of the expedients adopted to overcome this difficulty of constant speed will be mentioned subsequently.

Sometimes several pumps are installed so that the principal pumps may be kept running and variations in flow taken care of by starting and stopping one or more smaller ones. This arrangement is expensive.

Perhaps one of the most ingenious methods of providing for variations in capacity where an electrically driven plunger pump is used, is that devised by the late eminent engineer, Bruno V. Nordberg. Fig. 1 shows a variable-stroke pump designed by him for the Calumet & Arizona Mining Company. It will be noted that by the mechanism developed for this pump the stroke of the plungers can be varied at will. This means that with a constant-speed motor the capacity can be varied to suit the flow.

Another method of varying the capacity adopted for plunger pumps is to belt the motor to the pump, interposing a speed changer of the Reeves type between the two. This works quite well, but has the drawback of requiring considerable room; and it is better to keep belting out of a mine.

Another expedient employed with plunder pumps is the use of a multiplicity of plungers, say five, arranged so that one or more may be uncoupled and the capacity reduced accordingly. This is cumbersome, and sometimes sets up unbalanced stresses that are objectionable. If the plungers are single acting, provision must also be made to hold the idle plungers in place against the hydraulic pressure of the others.

With centrifugal pumps it is easy to vary their capacity by throttling the discharge. This has become a popular method, even though the efficiency decreases as the rate of discharge is reduced. There are mines where frequent starting and stopping of the pumps is prevented by throttling the discharge down to about the rate of water flow in the mine. Where pumps run continuously under these conditions, power costs are unnecessarily high. Sometimes the intake is throttled. While that is effective, there is danger of cavitation's causing destructive shocks and corrosion in the pump.

There are methods in use for varying pump capacity that are more efficient than the two just mentioned.

1. Adjusting the speed.
2. Automatic starting and stopping.

Making a small speed change will effect a surpisingly large variation in the capacity of a centrifugal pump. This is readily obtained with a motor of the wound-rotor type. While speed variation for a plunger pump can be

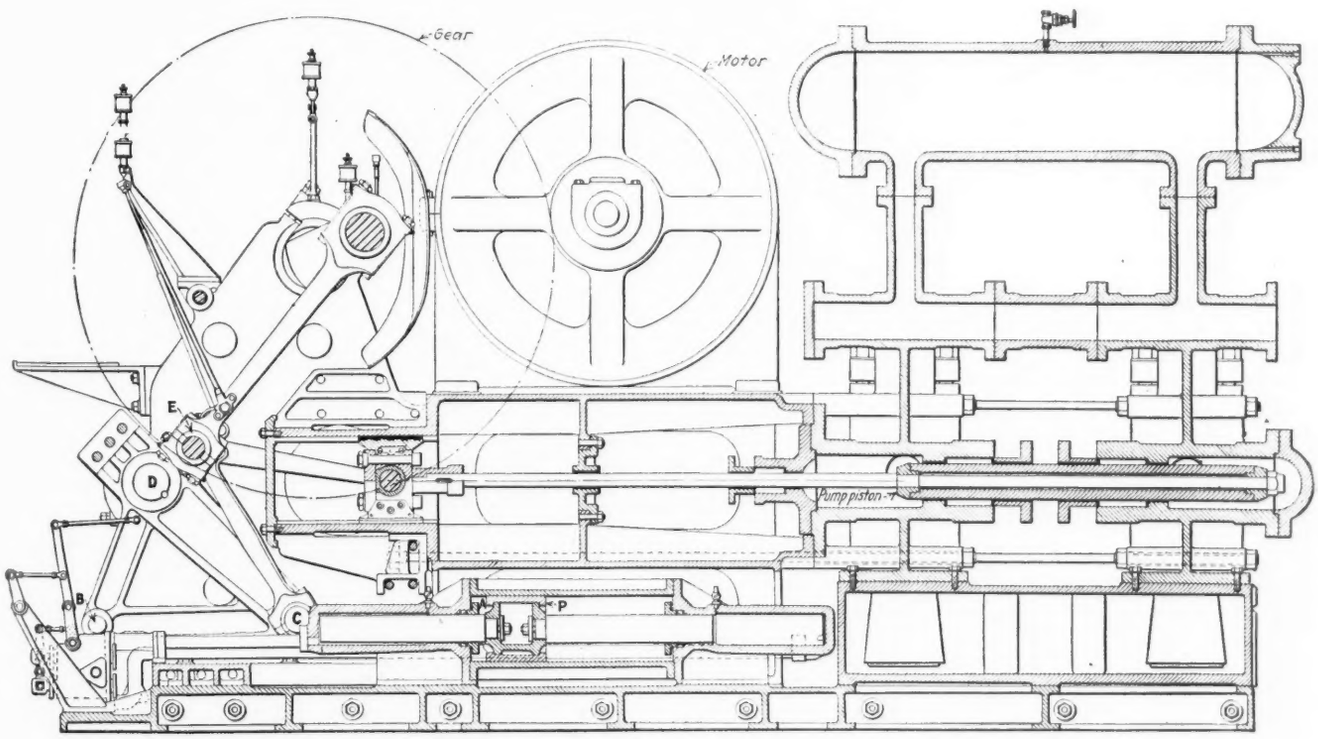

FIG. 1—A VARIABLE-STROKE VARIABLE-CAPACITY PLUNGER PUMP

Piston *P* is attached to the variable-stroke mechanism at *B*. Pressure fluid admitted into *A* back of piston *P* causes the latter to move to the right. In doing this, arm *C D* is caused to move about the center *D*. The end of arm *C D*, the crosshead on the pump's piston, and the driving crank all connect to *E*. When *C* is moved upward it shifts the position of *E* and changes the length of the pump's piston stroke and varies the column of water handled accordingly.

obtained by this means, it is not a particularly efficient method, because of the power loss in the secondary resistance. On the other hand, the power loss is relatively small when the speed of a centrifugal pump is changed sufficiently to produce a large change in capacity. A study of the speed-capacity characteristic curves of commercial centrifugal pumps available will show that speed adjustment provides a means of varying the capacity. This method has been somewhat overlooked in mining. Installations are in operation where advantage has been taken of this means for control of capacity. As an example, speed changes are obtained by varying the amount of resistance in the motor's secondary circuit by a motor-driven drum controller. The movement of the controller motor is regulated through relays by a float in the sump or by a pressure plunger in the intake.

If it is not desirable to install the rather elaborate equipment necessary for complete automatic control, a hand-operated drum controller will provide a convenient method of readily varying the capacity, and it is more efficient than throttling the discharge or intake. It is frequently possible to adjust the capacity to about the rate of inflow, after which little attention is necessary. This system allows a nice adjustment of capacity to flow without undue loss of efficiency.

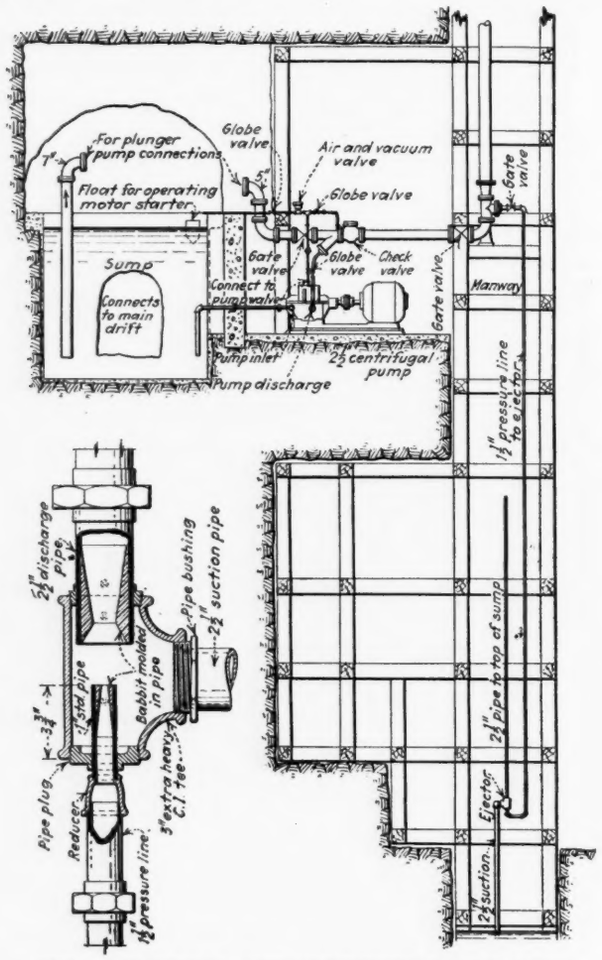

FIG. 2—GENERAL ARRANGEMENT OF AN AUTOMATIC UNDERGROUND PUMPING PLANT

In the lower left is shown a cross-section of the ejector used to lift the water from the mine shaft into the sump.

Automatic starting and stopping of pumping equipment makes it possible to operate such equipment at its maximum efficiency. With the equipment now available for automatic starting of motors, controlled by float or pressure gage, such operation of plunger pumps offers no particular problem. With centrifugal pumps the difficulty of priming for a long time presented a serious problem. In recent years this has been so well overcome that automatic starting and stopping now offers a practicable means to good efficiency.

Automatic priming can be done in several ways. One method uses an air pump, automatically started by a float switch when the sump fills up, which exhausts the air from the main pump. By using relays, primarily actuated by a float in a chamber which moves when the pump is filled with water, the main motor is started, stopped when the pump is emptied, and started again when the pump fills up once more. There are arrangements in the control system also which will shut down the main pump motor and ring an alarm in case the pump fails to prime.

Other systems of automatic priming depend upon a large storage chamber on the suction line, placed above the pump's center line in such a manner as to draw in the water at or near the top, and to maintain a storage of water for priming the pump when starting up after a shut down. Arrangements are made for separating the air which enters the suction line at each shutdown.

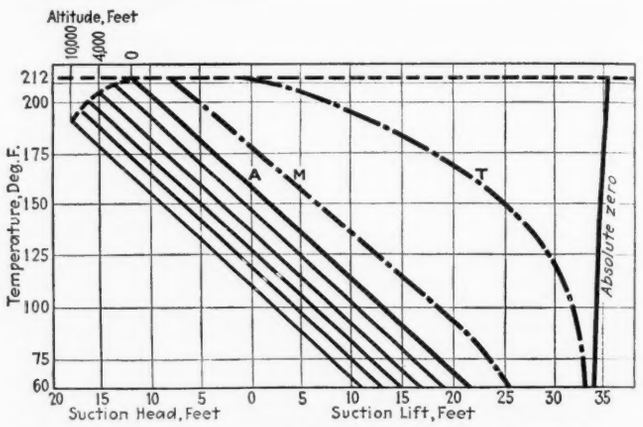

FIG. 3—THE CURVES SHOW THE EFFECTS OF ALTITUDE ON A PUMP'S PERFORMANCE

Curve *T* is the theoretical suction lift. Curves *A* indicate the attainable suction lift at different altitude. Under favorable conditions higher values may be attained, which for sea level are shown on *M*.

While these systems work well, for automatic starting, nothing is quite equal to a pressure inlet. It is not so difficult to arrange for this as is generally supposed. Fig. 2 shows an installation that has been operating successfully for several years. In this case a sump or reservoir was excavated below the general level of the main drift being drained, with a small pump room separated from it by a concrete wall. A pressure inlet line leads through this to a 250-gal.-per-minute, 200-ft. head, 3-stage centrifugal pump driven by a 50-hp. squirrel-cage motor. This motor is started and stopped by an automatic compensator, controlled by a float-switch relay, according to the variations of level in the reservoir. The location of a plunger pump is indicated. This was installed so that if the electric power should fail the plunger pump could be started on air supplied by a steam-driven compressor. Ball bearings on the pump and the motor relieve any anxiety about bearings running hot during the absence of attendants. The automatic feature of this installation has proved so successful that no regular attendant is maintained at the pump other than occasional inspection to see that the oil supply is kept up and to check up the compensator.

But it was realized that the system might become air

bound; the pump casing and discharge line were fitted with a ½-in. air and vacuum relief valve, piped up as shown. An amusing difficulty was encountered at first by reason of the small piping having been installed out of line horizontally, causing water to trap against the air and vacuum valve. After rearranging the piping no further trouble was experienced.

The ejector, shown at the bottom of the shaft in Fig. 2, is of the type previously mentioned, used for the hydraulic lifting of water. It is shown in detail, in the lower left of the figure, as made up in the mine shops. The ejector was used to clear the shaft sump of water not collected in the main reservoir. The water pressure available from the main pump column was used to lift this water into the reservoir to which the pumps suction is connected.

Another method of overcoming priming difficulties when starting centrifugal pumps has been used successfully in a Western metal mine. Deep-well pumps are piped up in series with the high-head pumps on the main level. By this means all motors are kept above water. The deep-well pumps, being submerged, are self-priming. The motor controls are so arranged that pushing a button starts a deep-well pump. By the time this pump is up to speed and delivering water to the main pump, the motor driving the latter starts, and shortly both pumps are operating as a series unit.

There are several advantages in an arrangement of this kind. In addition to self-priming, greater capacity and efficiency are obtained in the main pump. Too great a suction on a centrifugal pump may lower the efficiency and capacity to an unexpected extent. Nearly all the mines in the western states are located at fairly high altitudes. In addition, the water to be handled is frequently warm, even hot in some cases. That is why pumps designed, built and tested near sea level sometimes do not give in service quite as good performances as in the factory tests.

The curves in Fig. 3, taken from "Kent's Mechanical Engineering Handbook," show the effect of altitude and temperature on practicable suction lifts. On the whole, it will be found that better all-around performance is obtained if a positive pressure is maintained on the suction end of centrifugal pumps. This is of such importance as to justify some expense to arrange the installation to obtain such a layout.

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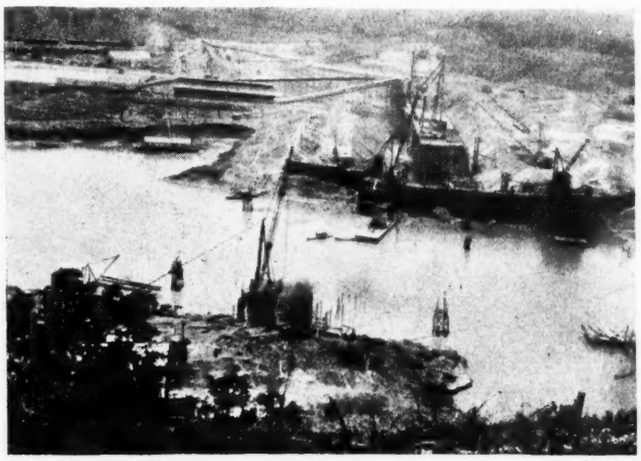


Pouring concrete on Osage River Dam

Progress at Osage River Dam

RAPID PROGRESS is being made by Stone & Webster in the construction of the Osage River, Mo., dam, which when finished will create a lake some 150 miles long. The hydro power will be distributed by the Union Electric Light & Power Company of St. Louis.

The initial work of building dining rooms, cottages and other buildings proceeded so rapidly that actual construction of the dam began ahead of schedule, 10 per cent of the total program being finished by May.

A somewhat baffling problem encountered is the disposal of the Camden County Court House. This is in Linn Creek, which town has been purchased by the Union Electric Light & Power Company, and will be submerged under 20 ft. of water.

A fraction of the people object to permitting the power company to buy the court house, so that an election will be necessary. If the power company loses this election, the problem to be worked out is how to submerge the town and yet keep the court house dry.

Oil Engine Piston Rings

By B. S. Gupta
Kiel, Germany

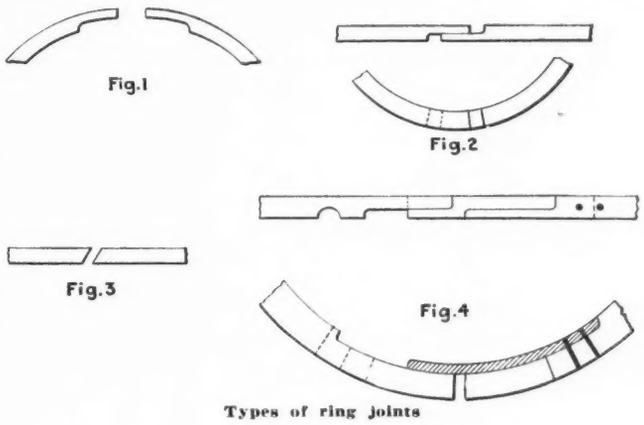
FROM time to time articles have appeared in *Power* on the subject of oil engine piston ring gaps. The practice in use in a large German factory may prove of value to engineers in charge of this type of engine.

If the inside of the ring is relieved in the manner shown in Fig. 1, which has been advocated by some, the cross-section of the metal is diminished and the ring will be forced in contact with the cylinder liner. A gas-tight contact will result, but there is an opportunity for gas to escape past the ring at a point opposite the gap.

To minimize such an escape, we have supplied most of our Diesel engines with the ring shown in Fig. 2.

Engines of small capacity are fitted with rings similar to that in Fig. 3, which has an oblique gap. If the several rings are placed on the piston so that the gaps are staggered, the gas has a tortuous path to travel, so the seal is fairly satisfactory.

Some of our large Diesels are fitted with rings illustrated in Fig. 4. But the arrangement has been found to be unserviceable, as the riveted lip gives way during operation.



Types of ring joints

HIGHER

Steam Pressure *and* Byproduct

A combination of 650-lb. pressure boilers fired with powdered coal, back-pressure turbine-generators and an accumulator shows remarkable economy. Balance is secured between power and process steam and pressures are maintained constant. Compared to results from the old plant and part purchase of electrical power, mill capacity has been increased 50 per cent and total cost of the power and steam, based on present output, has been reduced over $250,000 annually

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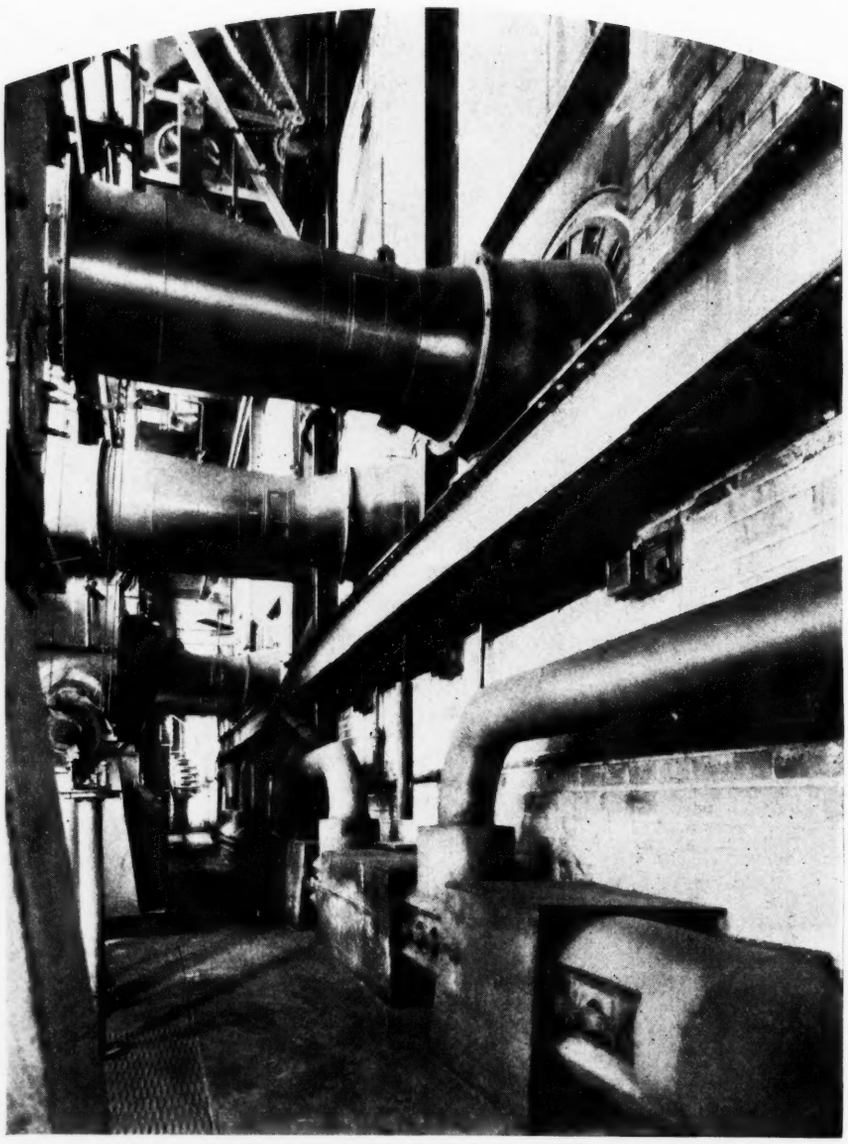

Operating floor level showing burners at right and feeders at left

IN 1927 the Waldorf Paper Products Company, of St. Paul, Minn., maker of binder and insulation boards came to the point where it seemed desirable to increase the productive capacity of the mill and at the same time improve the operating conditions in the power plant. Naturally this decision called for an analytical study of conditions, which revealed certain interesting facts.

It was found that by increasing the boiler pressure from 175 to 650 lb. and installing more economical back-pressure generating units a practical balance could be established between power and process steam and maintained continuously by the aid of an accumulator. By recovering the full power requirement of the mill (about 3,000 kw.) from the process steam between the initial and back pressures proposed, it would be possible to eliminate the purchase of power, which was being done to the extent of one-half the requirements. By certain changes in process equipment and process operation, capacities of the two existing paper machines could be increased 50 per cent.

These advantages were to be obtained with the generation of no more steam per ton of product than had been used in the past to supply one-half the power load and the process demand, and with the installation of more economical equipment, the cost of making the steam would be considerably reduced. Over all, a saving in operating expense of 25 per cent per ton of board was anticipated on an investment in the power plant totaling $750,000.

In the old installation the major equipment consisted of six straight-tube, longitudinal, two-drum boilers aggregating 26,480 sq.ft. of surface. Two of the boilers were served by underfeed stokers, the other four by overfeed stokers. Five of them were required to carry the load, leaving one boiler as a reserve unit. The operating pressure was 175 lb. gage.

Three 250-volt direct-current generating units aggregating 1,300 kw. capacity were in service in the engine

Power Generation

SAVE $250,000 *ANNUALLY*

By THOMAS WILSON
Associate Editor of POWER

room. One, of 600-kw. capacity, was directly connected to a horizontal twin engine, and the other two machines, of 350 kw. capacity each, were directly connected in one case to a twin vertical engine and in the other to a compound vertical engine operating condensing. In addition there were three motor-generator sets and two banks of transformers to step down the voltage of the purchased current from 4,000 to 440 volts alternating current. Part of the supply was used at the latter voltage and the balance converted to 220-volt direct current.

Exhaust steam from the non-condensing units at 15 to 18 lb. pressure was used in the dryers of the paper machines, except at the calender end of the machines, where at times live steam reduced to 45 lb. pressure was needed. Power demands in addition to that supplied by the units exhausting to process were met by a condensing unit and purchased energy.

A study of these conditions revealed the uneconomical practice of operating in part condensing and in addition purchasing a large block of power, when the two services, power and process steam, might be more economically combined. Economy would be served by raising the steam pressure to a point that would establish a balance at the extreme condition between power and process steam. This, of course, would necessitate full back-pressure operation and the selection of generating units having a water rate that in the aggregate would correspond with the process-steam demand.

In the analysis, it was estimated that the low-pressure steam demand would range from 24 to 36 lb. for every kilowatt-hour of electrical energy used. Against back pressure of 25 lb., generating units might be selected with water rates approximating 36 lb. per kilowatt-hour, with steam at an initial pressure of 200 lb. and 60 deg. superheat; 24 lb. with steam at 400 lb. pressure and 175 deg. superheat; and 21 lb. at 600 lb. and 200 deg. superheat. The 25 lb. back pressure allowed for friction drop in the pipe lines, so that a pressure of 18 to 20 lb. might be maintained in the dryers, or at other points of use. To cover the additional requirement for process steam at 45 lb. pressure, it would be possible with an initial pressure of 600 lb. to raise the back pressure to this point and by so doing increase the water rate to only 24 pounds.

The highest initial pressure mentioned gave a margin that seemed desirable, even though the investment would be considerably increased. Instead of using live steam direct to make up any deficiency in process requirements, it was decided to install an accumulator that would absorb all surplus steam and give it out to process during periods of deficiency. By evening out the peaks and the valleys in this way, it was possible to use somewhat smaller boilers, and establish a balance between power and process steam that would result in maximum over-all efficiency.

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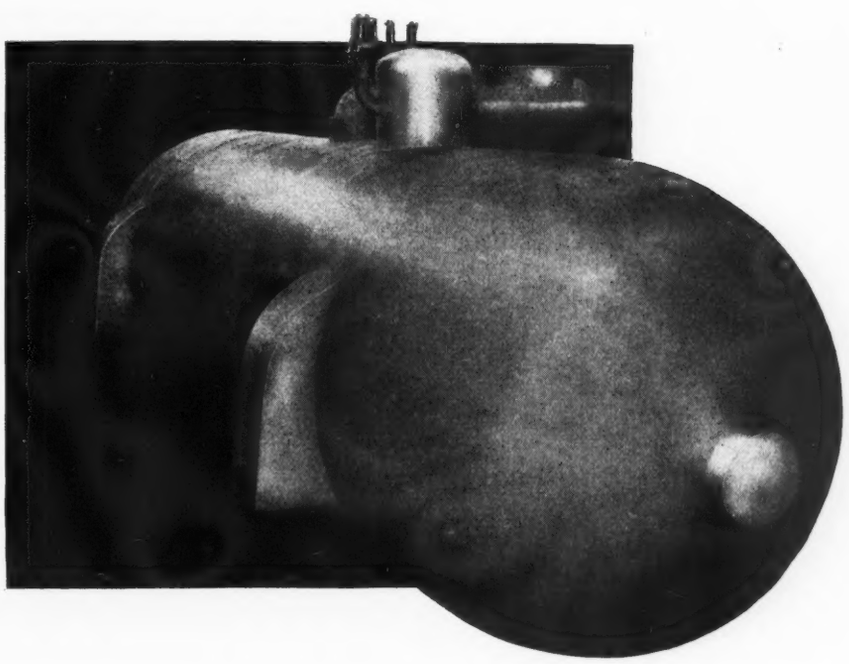


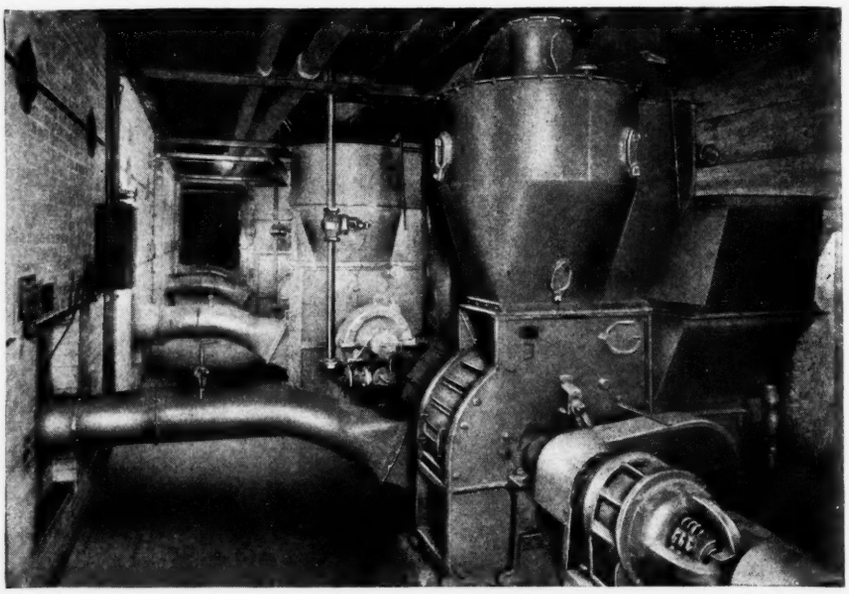
ACCUMULATOR, MOUNTED ON TOP OF THE BUILDING,

has a volume of 12,000 cu.ft., a diameter of 16 ft. and a total length of 65 ft. It is built for a maximum working pressure of 82 lb. Between a pressure range of 75 and 15 lb., its capacity is 44,000 lb. of steam. Steam-storage capacity, however, changes with the pressure range, so that for the present operating range of 70 to 44 lb., the capacity reduces to 14,500 lb. of steam.

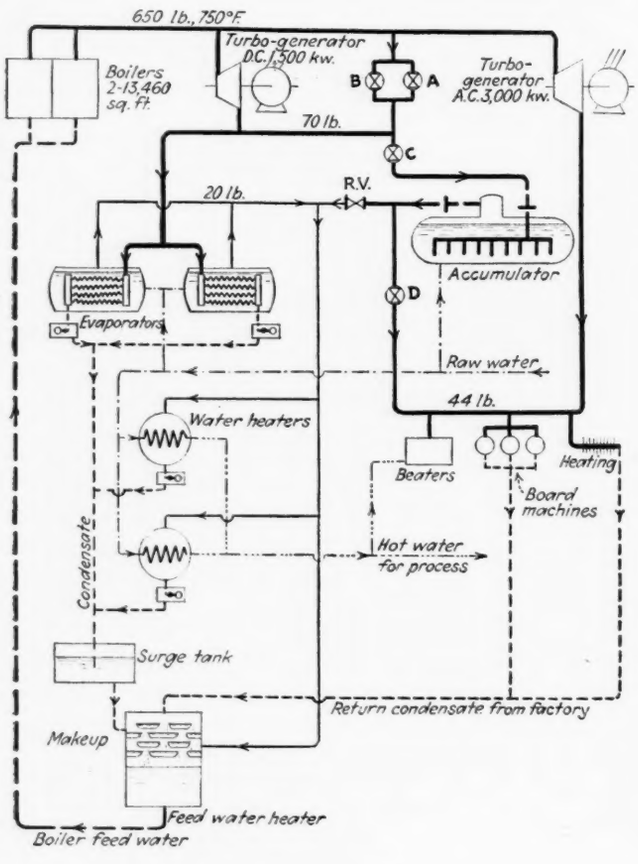
With these porspects in view, it was decided to build a new plant and house it in the existing building. Space limitations imposed difficulties in the layout, making it necessary to install some of the equipment on second and third floors. Likewise, the problem of removing old equipment and installing the new plant while maintaining service added to the complications that had to be overcome. The overhead coal bunker, of 1,000 tons' capacity, was retained, as well as the track hopper and skip hoist of the old plant, and a weigh larry that was rebuilt to meet the new conditions.

The schematic diagram through the system indicates the new layout. Two 13,460-sq.ft. boilers of the single-pass type, fired with pulverized coal and equipped with tubular air heaters, replace the six old stoker-fired boilers. Built for a working pressure of 650-lb. and a total steam temperature of 750 deg. F., these boilers deliver steam to two turbine-generators, one a direct-current geared machine of 1,500 kw. capacity supplying the mill demand for direct current, and the other a 3,650-kva. unit supplying the alternating-current load.

Both operate non-condensing, the alternating-current machine exhausting at a constant pressure of 44 lb. into the process system to supply the steam for heating, paper drying, kilns, and hot water. The other unit exhausts at a constant pressure of 70 lb. into an intermediate line that supplies steam to the evaporators and to the accumulator.



One of the 6-ton mills of the self-contained unit type



Schematic diagram of system

Steam to the generating units from the 650-lb. boiler supply line is controlled by the speed governors of the turbines. The rest of the steam generated, should the process exceed the power demands, passes directly through either of the two overflow valves *A* and *B* (in the diagram) to the 70-lb. turbine exhaust line. By the overflow valve *C* the pressure in this line is kept constant, as it passes all surplus steam to the accumulator, which, in turn, passes it out through the reducing valve *D* to the process line in accordance with the demand. Should the supply exceed the demand, the surplus is stored in the accumulator, and if the conditions are reversed, make-up steam from the accumulator flows into the process line. In this way a balance between process and power steam is maintained. Another function of the accumulator is to desuperheat the steam for process taken from the high-pressure line.

It should be explained that valves *A* and *B* not only operate as overflow valves for the 650-lb. steam, but also as reducing valves should the pressure in the turbine exhaust line drop below normal, and as limit pressure valves to guard against a rise in pressure in this line. Valve *C* acts as an overflow valve for the turbine exhaust line, as a reducing valve in case the accumulator should be discharged to its minimum pressure, and as a limit pressure valve if the accumulator is loaded up to its maximum pressure.

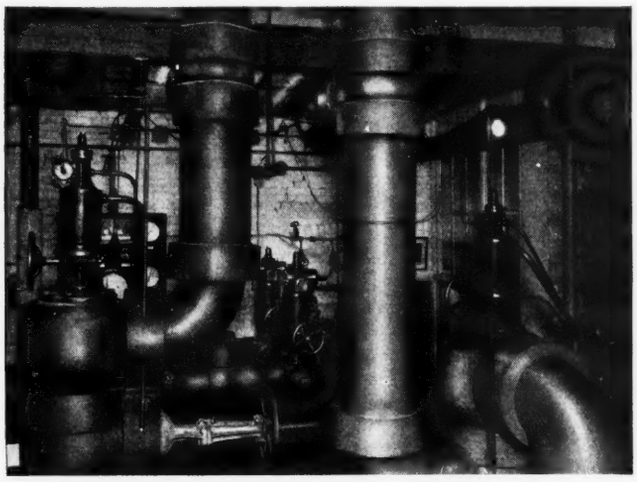
Evaporators on 70-Lb. Line

It will be seen from the diagram that two evaporators also draw from the 70-lb. exhaust line. Boiler make-up from the deep-well supply on the premises is delivered through a primary heater to these evaporators. The vapor is delivered to two closed heaters used to heat water for the manufacturing processes and to an open, deaërating feed-water heater. Condensate from the evaporator coils and the hot-water heaters is collected in a surge tank delivering to the open heater, which also receives the returns from the mill. From this point the deaërated water is fed to the boilers by two multi-stage pumps of 275 gal. per minute capacity. Steam for the

closed and open heaters also may be drawn from the accumulator.

The boilers are of the single-pass four-unit type with a closed-circuit steaming section at the front and a heater or economizer section with vertical tubes at the rear. Of the 13,460 sq.ft. of heating surface in each boiler, 8,730 sq.ft., in 2-in. tubes, is in the heater section, and 4,730 sq.ft., in 3¼-in. tubes, is in the steaming section. Water walls protect the refractory of the furnace walls and ashpit. By setting the water drums of the steaming section 17 ft. above the operating floor, a furnace volume of 11,700 cu.ft. was provided. At maximum rating the heat release is 18,000 B.t.u. per cubic foot per hour.

Steam from the main drum passes to an external



CONTROL VALVES OPERATED AUTOMATICALLY BY OIL
Steam flows through the two 3-in. high-pressure valves (center) only when process requirements are greater than the turbines' steam demand. The 12-in. valve at the left passes steam to the accumulator and maintains a constant pressure in the 70-lb. line. The 14-in. reducing valve (right) is between the accumulator and the process-steam load.

purifier from which delivery is made to ths convection superheater, located between the two sections of the boiler. Back of the heater section is a tubular air heater. At maximum boiler rating, 400 per cent, the gases leave the preheater at 350 deg. F. and the air for combustion at 10 deg. lower.

Feed Water Automatically Controlled

Feed-water regulators in combination with differential-pressure pump governors control the feed to the boilers. Operation is regulated by a system of combustion control functioning from the steam pressure. Instruments are provided to record the flue gas and air temperatures entering and leaving the preheaters, to record the temperature of the steam, and also the steam and the air flow. Draft gages and other indicating instruments give additional data necessary for efficient boiler operation.

Each of the two boilers is fired by two unit pulverizers having an individual rating of 12,000 lb. per hour and an overload capacity of 3,000 lb. additional. These machines are mounted on the basement floor, with the feeders and the burner piping on the operating floor above. They are driven by 125-hp. motors which also supply the power for handling all primary and secondary combustion air through the mill with the coal. A fifth pulverizer, of 1,500 lb. per hour capacity, has been provided and is so connected that it may be used to warm up either furnace when starting a boiler or holding a fire on extremely light loads, such as would occur on Sundays and holidays during the non-heating season.

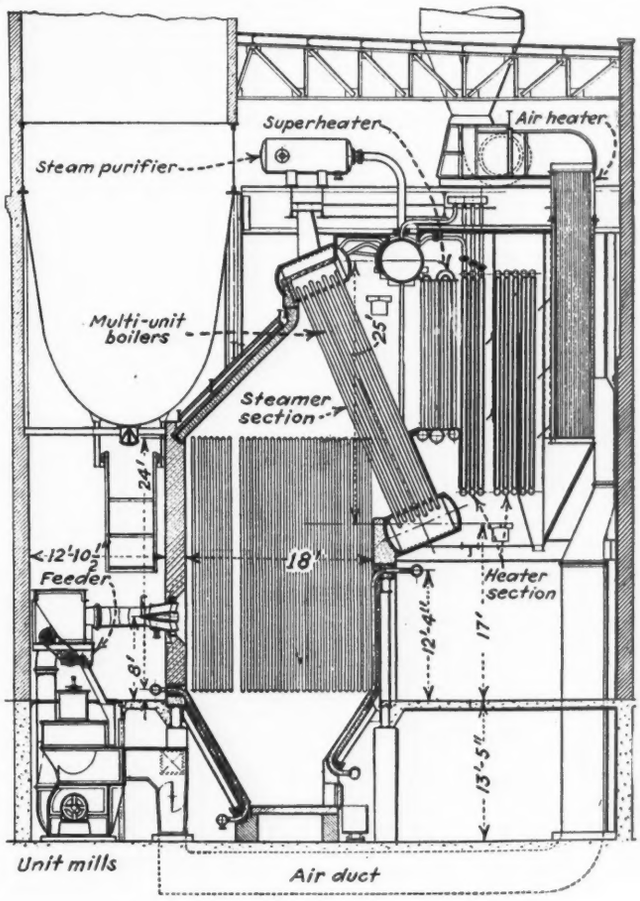
Since the pulverizers are of the self-contained unit type, with the pulverizing rotor and air-handling fan mounted upon one shaft, no auxiliary air-handling equipment is necessary. The pulverizer fans draw the preheated air from the tubular air heaters to the pulverizers, where it picks up the fuel for burning and conveys it to the two turbulent-type, horizontal, water-cooled, vortex burners serving each furnace. Both the fuel and the air supply are regulated by the combustion-control system.

In the turbine room the first unit to be installed was the 1,500-kw., 250-volt direct-current machine. When it was ready for service, the engine units were removed and the alternating-current turbine-generator was installed. Rated at 3,750 kva., this machine delivers 3-phase, 60-cycle current at 440 volts.

To make it possible to supply either direct current or alternating current, should one of the main units be down, a motor-generator set consisting of a 600-kw., direct-current end and a 1,000-kva. synchronous machine were installed. The set is used also to improve the power factor of the system. For the same reason a 350-hp. synchronous motor was selected to drive a 2,100-cu.ft. air compressor used to supply air at 110 lb. pressure for an air-lift system and for the operation of air hoists and other miscellaneous tools.

What a Year's Operation Has Shown

The plant, with the accumulator installed, has now been in operation for over a year. Capacity in the board mills has been increased from 150 to 225 tons per day, with sufficient reserve for a maximum capacity of 300 tons. With the accumulator, one boiler at an average

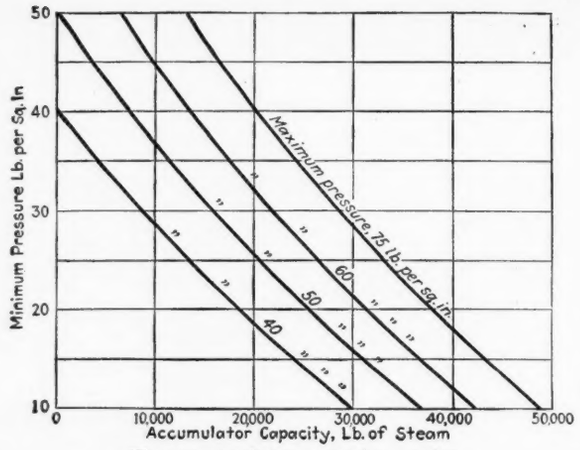


Section through one of the boiler units

rating of 300 to 350 per cent meets all of the present power and process-steam demands. The boiler pressure is maintained constant and the back pressures are held at approximately 70 lb. on the direct-current machine and 44 lb. on the alternating-current unit, discharging direct to process.

Results of Operation With Various Coals

The table gives results for nine weeks' run at the plant during which various kinds of coal were tried out. With coal running from 6 to 9 per cent ash and 2.6 to 6.38 per cent moisture, the evaporation ranged from 11.46 to 12.556 lb. per pound of coal. Steam pressures were constant, but maintained at slightly different levels from one week to another. The average output ranged from 81,000 to 112,200 lb. of steam per hour, corresponding to an operating rate of 202 to 285 per cent. During the week of Oct. 26 operation was carried to a



The accumulator capacity varies with the range of pressure

Boiler Room Performance Data

For week ending	5-18-1929	5-25-1929	6-1-1929	6-8-1929	6-15-1929	6-22-1929	6-29-1929	10-26-1929	11-2-1929
Hours operation	144	144	116	144	120	144	144	144	144
Water evap., lb.	12,413,400	11,617,800	10,577,400	11,902,600	10,410,000	14,137,000	12,627,600	16,143,750	15,451,500
Coal burned, lb.	1,234,000	1,180,000	1,063,000	1,154,000	987,000	1,374,000	1,184,000	1,520,298	1,531,098
Actual evap., lb	10.06	9.85	9.95	10.314	10.547	10.289	10.661	10.62	10.48
Factor of evap.	1.1707	1.165	1.1721	1.1717	1.1715	1.1872	1.1778	1.181	1.186
Evap. f. and a. 212 deg., lb	11.77	11.46	11.66	12.085	12.35	12.214	12.556	12.55	12.45
Steam press., lb.	641	646	645	640	642	646	637	640	645
Steam temp., deg. F.	720	715	724	722	716	734	731	724	736
Superheat, deg. F.	224	219	227	226	220	237	236	228	239
Feed-water temp., deg. F.	255	258	255	255	251	246	255	247	247
Temp. air in preheater	98	100	103	102	97	111	105	96	93
Temp. air out	301	299	310	306	297	347	317	325	328
Temp. gas in.	400	391	401	421	408	447	415	423	423
Temp. gas out	332	318	329	334	336	376	360	348	347
Coal	W.Va. Splint	Ill. & W.Va. Sp.	Ill. & W.V. Sp.	Spl & Poca.	Spl & Poca.	W.Va. Spl.	R. & P.	R. & P.	R. & P.
F. C.	52.87	50.52	53.13	53.07	61.34	56.70	58.30	60.05	60.15
Vol.	34.82	34.50	34.65	34.55	28.22	31.75	29.65	28.85	28.20
Ash	7.52	9.00	5.84	7.95	6.94	7.05	7.50	8.50	7.75
Moisture	4.79	5.98	6.38	4.43	3.50	4.50	4.55	2.60	3.90
Sulphur	2.13	1.66	1.29	1.83	2.06	1.70	1.21	1.92	1.16
B.t.u. as fired	13,000	12,700	12,980	13,450	13,810	13,507	13,756	13,885	13,861
Steam per hr., lb.	86,500	81,000	91,000	83,000	87,000	98,000	88,000	112,200	111,500
Average rating, per cent	218	202	230	219	219	246	223	285	285
Maximum rating, per cent	.....	.....	270	283	283	290	300	355	310
Operating efficiency, per cent	87.9	87.5	87.2	87.2	86.8	87.8	88.6	87.7	87.1
Guaranteed efficiency, per cent	86.8	86.8	86.75	86.77	86.77	86.7	86.77	86.5	86.6
CO_2, per cent	.....	.....	.....	.....	.....	.....	.....	14	14.2
Heat release, B.t.u.	.....	.....	.....	.....	.....	.....	.....	12,600	12,700

New Mechanical Equipment in the Power Plant

Boilers and Auxiliaries

Boilers, two, single-pass, four-unit	Edge Moor Iron Co.
Steamer section, 3½-in. tubes, sq.ft.	4,730
Heater section, 2-in. tubes, sq.ft.	8,730
Total boiler surface, sq.ft.	13,460
Working pressure, lb. gage	650
Steam temperature, deg. F.	750
Furnace volume, cu.ft.	11,700
Heat release at 400 per cent rating, B.t.u. per cu.ft. per hr.	18,000
Water walls, 4-in. tubes, 12,000 sq.ft.	Foster Wheeler Corp.
Refractory walls	Michael Liptak
Superheaters, return-bend, 250 deg. F.	Foster Wheeler Corp.
Steam purifiers, two	Cochrane Corp.
Air heaters, two, 2½-in. tubes, 15,200 sq.ft.	Edge Moor Iron Co.
Temp. gases leaving heater at 400 per cent rating, deg. F.	350
Temp. air leaving heater at 400 per cent rating, deg. F.	340
Unit pulverizers, 2 per boiler, 12,000 lb. per hr.	Strong-Scott Mfg. Co.
Drive, 125-hp. motor, 1,750 r.p.m.	Westinghouse Elec. & Mfg. Co.
Unit pulverizer one, supplementary, 1,500 lb. per hr	Strong-Scott Mfg. Co.
Drive, 20-hp. motor, 1,750 r.p.m.	Westinghouse Elec. & Mfg. Co.
Burners, two per boiler, Vortex No. 5	Strong-Scott Mfg. Co.
Soot blowers	Diamond Power Spec. Corp.
Fans, induced-draft, two	Bayley Blower Co.
Drive, 300-hp. motor, 850 r.p.m.	Westinghouse Elec. & Mfg. Co.
Combustion control	Carrick Engineering Co.
Feed-water regulators, Copes	Northern Equipment Co.
Pop safety valves	Consolidated, Ashcroft, Hancock Co.
Blowoff valves, Yarway	Yarnall Waring Co.
Stop and check valves	Edward Valve & Mfg. Co.
Water columns, 2 per boiler	Stets Co.
Steam piping	Crane Co.; Midwest Piping & Supply Co.
High-pressure valves	Crane Co.; Walworth Co.
Low-pressure valves	Crane Co.
Insulation	Philip Carey Co.

Steam-Storage System

Accumulator, 16 ft. diam., 65 ft. long, 12,000 cu.ft.	Ruths Steam Storage, Inc.
Max. working pressure, lb. gage	75
Operating conditions, lb. gage	70 to 44
Regulating valves	Ruths Steam Storage, Inc.
Insulation	Johns-Manville Corp.

Feed-Water System

Pumps, feed water, two, Cameron	Ingersoll-Rand Co.
Capacity at 800 lb. head, g.p.m.	375
Drive, 300-hp. motor, 1,750 r.p.m.	Westinghouse Elec. & Mfg. Co.
Pump governors, differential	Mercon Regulator Co.
Heater, open, deaerating, 230,000 lb. per hr.	Cochrane Corp.
Evaporators, two, bent tube, 22,000 lb. each per hr.	Griscom-Russell Co.
Heaters, Reilly, two, process water, 450,000 lb. per hr.	Griscom-Russell Co.
Air compressor, general air supply and for air lift	Ingersoll-Rand Co.
Capacity, 110 lb. pressure, cu.ft. per min.	2,100
Drive, syn. motor, 350 hp., 200 r.p.m.	Westinghouse Elec. & Mfg. Co.

Generating Units

Turbine-generator, one, geared d.-c. unit, 1,500-kw., 250-volt	Westinghouse Elec. & Mfg. Co.
Steam conditions, 630 lb., 725 deg. F., 70 lb. back pressure	
Speed turbine and generator, r.p.m.	3,457 and 514
Turbine-generator, one a.-c. unit, 3,750-kva.	Westinghouse Elec. & Mfg. Co.
Steam conditions, 630 lb., 725 deg. F., 44 lb. back pressure	
Generator, 3-phase, 60-cycle, 440-volt., 3,600-r.p.m.	
Surface air cooler, a.-c. generator, 1,580 sq.ft.	General Electric Co.
Coolers, multiwhirl, gland sealing water	Griscom-Russell Co.
Motor-generator set, 1,000-kva. syn. motor, 600-kw. d.-c.	Westinghouse Elec. & Mfg. Co.
Switchboard	Westinghouse Elec. & Mfg. Co.

Meters

Temperature recorders	Bailey Meter Co.
Pressure recorders	Bailey Meter Co.; Foxboro Co.
Steam-flow, air-flow	Bailey Meter Co.
Feed-water meter	Bailey Meter Co.
Pressure indicating gages	Consolidated, Ashcroft, Hancock Co.
Draft gages	Bailey Meter Co.

maximum rating of 355 per cent. In these figures no credit is allowed for steam used by the soot blowers, for blowdown, or for the coal used in starting. Economies obtained are high, ranging from 86 to 87 per cent. Including overhead, cost of generating 1,000 lb. of steam runs from 36 to 38 cents.

As the temperature of the steam bypassed from the boiler main to the 70-lb. line ranges from 725 to 750 deg. F., arrangements were made to desuperheat it in the accumulator. Because of the desuperheating effect raw water has to be supplied to the accumulator at the rate of 3,000 to 10,000 lb. per hour, relieving the demand on the evaporators for make-up water, so that this equipment, as well as the boilers, is of smaller size than otherwise would obtain.

Stabilized Pressure Speeds Production

It may be of interest to state that in the operation of the old plant, back pressure on the steam engines varied between 15 and 40 lb.; so it was necessary to operate the paper machines at a speed that would give dry paper even if the steam pressure in the drying cylinders should drop to 15 lb. In other words, it was necessary to maintain a safe margin. Since the installation of the new plant, the pressure in the paper machines has been maintained constant at 44 lb., and as the operators know that this pressure will remain constant, they feel perfectly safe in running the machines at a much higher speed without maintaining any extra pressure margin. This factor has resulted in increased product of a better quality and in better control of the drying process.

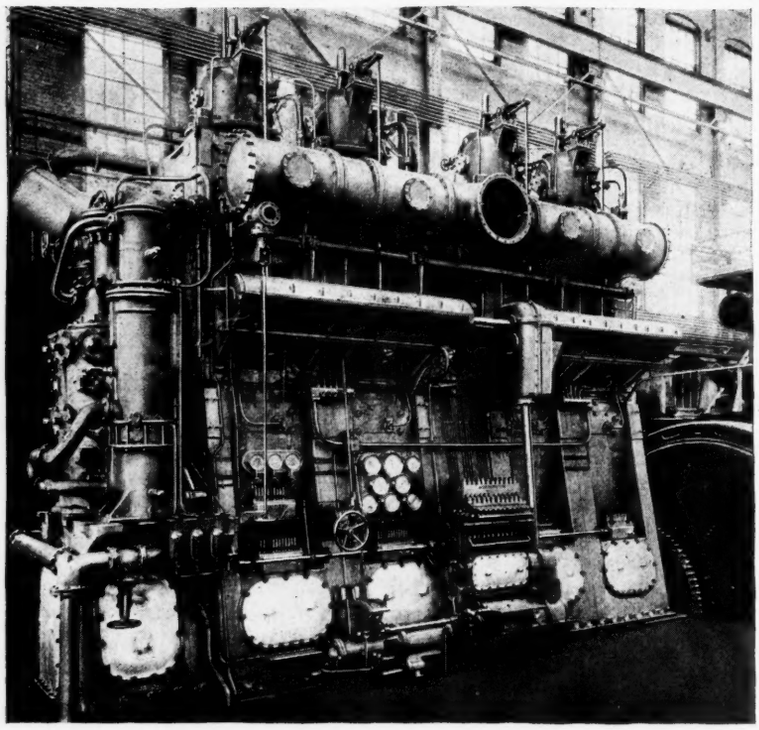
Another point of interest is the master gage which correlates the operation of the boiler plant with the accumulator. The rate of firing the boiler is regulated in accordance with the accumulator pressure shown on this gage. If the pressure drops too far, the rate of firing is increased, and when the pressure is up to maximum, the rate of firing is decreased. The pressure in the accumulator, however, changes much slower than would be the case with the boiler pressure, so that instead of regulating the boilers frequently, it may be necessary to change the firing once in two or three hours rather than every few minutes, and at times the rate of firing is maintained constant for periods as long as six to seven hours.

The two back-pressure generating units; 1,500-kw. geared d.-c. unit in the foreground; 3,750-kva., a.-c. machine in the background

Sought-For Load Balance Obtained

Summarizing, it may be stated that the results from the new power plant have met all expectations. The boiler plant has given excellent satisfaction and the accumulator has fulfilled all the claims made for it. The combination of high-pressure boilers, non-condensing turbines, and an accumulator acting as a balance wheel for the entire system has made it possible to obtain an excellent balance between the steam supply, on one hand, and the demand for power and process steam, on the other. Any variation in one or the other is automatically and promptly taken care of by the accumulator without causing any apparent disturbance in the steam supply pressures.

This interesting byproduct power development was based upon analytical studies and plans made under the direction of Ralph D. Thomas, consulting engineer, Minneapolis, Minnesota. Credit is due L. A. Breneman, who was then assistant general superintendent and chief engineer of the Waldorf Paper Products Company, for early recognition of some of the advantages to be attained by adopting higher steam pressures in this plant. A. J. Waldorf is general superintendent, and N. H. Sandberg is now assistant general superintendent and chief engineer of the company.



What Can Be Expected From a Diesel Plant

BY M. J. REED

Research Engineer
Deisel Engine Manufacturers' Association

SOME plainly evident conclusions can be drawn from the 1929 Report of the A.S.M.E. sub-committee on Diesel power costs,[1] although in some other directions the data do not as yet show established trends. If only what can be interpreted without too much contention is examined, the first subject to claim attention is fuel-oil economy.

Out of the total of 36 plants reported, 10 contain semi-Diesel engines, and for 5 capacity factors are not listed. It is preferable to consider only straight Diesel plants in analyzing fuel economy, and it is essential to have full information on engine loadings. Therefore, 21 plants containing 64 engines will be the basis for this study.

In Fig. 1 the fuel economies of these 21 plants, expressed in gross kilowatt-hours per gallon of fuel, are plotted against running plant capacity factors (this factor as used by the committee is the average per cent load carried by the engines of a plant while they are operated). It is evident that the points lie in a fairly definite zone bounded by the broken lines for "minimum economy" and "maximum economy." It should be borne in mind that these points represent average fuel economies over periods of twelve months, except the period for plant No. 26, which is for 18 months. In addition, the engines concerned are of almost every possible Diesel type, of a wide range of sizes, and of ages ranging from sixteen years down. It is of interest, also, that while plant averages are made the basis for the curves of Fig. 1, only five individual engine economies are outside the zone outlined: Using the numbers in the report, engine 43*h* with a separately-driven scavenging blower is above; engine 3*a* operating at 116 per cent capacity factor, which seems open to question, is off the chart; engine 3*d* is slightly over the zone, and engines 136 and 68*b* are slightly under.

These curves can be set down in silghtly different form, as in Fig. 2, where by assuming an average of 7½ lb. of fuel to the gallon, curves can be drawn to show pounds of fuel per gross kilowatt-hour. By assuming a reasonable generative efficiency other curves can be established to show pounds of fuel per engine brake horsepower-hour, as has been done in Fig. 2.

Manufacturers normally guarantee fuel consumption of Diesel engines in pounds of fuel per brake horse-

[1]This report was presented at the National Conference of the Oil and Gas Power Division, American Society of Mechanical Engineers at Pennsylvania State College, June 14, 1930.

power-hour at full, three-quarter, and half loads, these loads corresponding to 100, 75 and 50 per cent running capacity factors. From Fig. 2, the twelve months averages for these loads are:

POUNDS FUEL PER B.HP.-HR.

	At Full Load	At Three-Fourths Load	At Half Load
Maximum	0.495	0.52	0.60
Average	0.445	0.465	0.53
Minimum	0.40	0.415	0.47

These results show a remarkably narrow spread for so many divergent types, sizes, and ages of engines, and, even more interesting, an average which might easily be the average test guarantee for the group.

With so many variables and such a narrow spread of results it would seem that the effect of the operator upon fuel economy is negligible. However, while it is true that the operator can do very little to increase the fuel economy of an engine at any load, or impair the economy by not doing anything, the operator does have an opportunity to lower fuel *cost* in a large plant. This is borne out by the difference between the weighted average fuel cost of 0.4139c. per net kilowatt-hour and the arithmetical average of 0.4729c. The two averages are almost identical for the prices paid for fuel oil, 4.18 and 4.19c. per gallon, showing that the large plant cannot buy fuel any more cheaply than the small plant so long as both buy in tank-car lots.

The difference in the fuel cost per unit generated must therefore come from the better load factors possible in the large plant with several Diesel units. For instance, plant 43 can handle any load from 250 kw. to 8,000 kw. with engines always operating at over half capacity; whereas a smaller plant with fewer units cannot adjust loads so efficiently. This advantage is not merely theoretical, for 1.5 more kilowatt-hours can be produced per gallon at three-quarters load than at one-half load, as Fig. 1 indicates.

The economic spread between an old engine, of inefficient design perhaps, operating on poor fuel and in poor condition, and a new engine of improved design using good fuel and in good condition may be ascertained from Fig. 3. Although the average price paid by these plants for fuel oil was slightly over 4c. per gallon, a figure of 5c. was taken for Fig. 3, since the higher figure will include more territory.

Fig. 3 illustrates a rough rule that for any load over half the cost of fuel in *mills* per kilowatt-hour should be approximately the same as the cost of the fuel in *cents* per gallon.

The lubricating oil picture as shown by Fig. 4 is not surprising in view of the great effect that operation has upon lubrication economy. It is easy to understand why the members of the Diesel Engine Manufacturers' Association do not guarantee the lubricating-oil consumption, and to appreciate fully its statement that "the consumption of lubricating oil by a Diesel engine is affected not only by the mechanical design of the engine, but also by the quality of the lubricating oil, the arrangements for storing, cleaning and circulating, and the skill and integrity of the personnel of the plant."

It might be explained that the lines bounding the zone

In spite of the uniform efficiency of all types of Deisel engines there is always discussion as to the actual consumption of fuel and lubricating oil when the engine is in commercial service

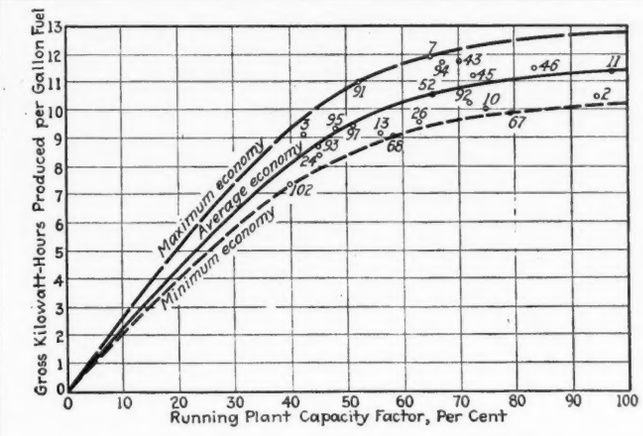


Fig. 1—Effect of capacity factor on fuel consumption

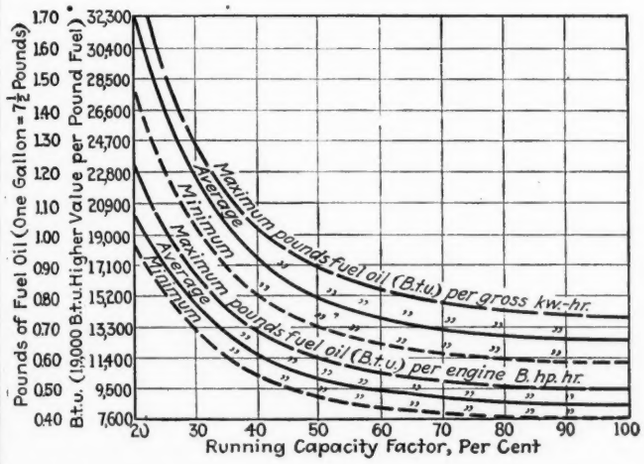

Pounds of Fuel Oil (One Gallon = 7½ Pounds)
B.t.u. (19,000 B.t.u. Higher Value per Pound Fuel)
Maximum pounds fuel oil (B.t.u) per gross kw.-hr.
Average
Minimum
Maximum pounds fuel oil (B.t.u.) per engine B. hp. hr.
Average
Minimum
Running Capacity Factor, Per Cent

Fig. 2—Valuation in pounds of oil per kilowatt-hour

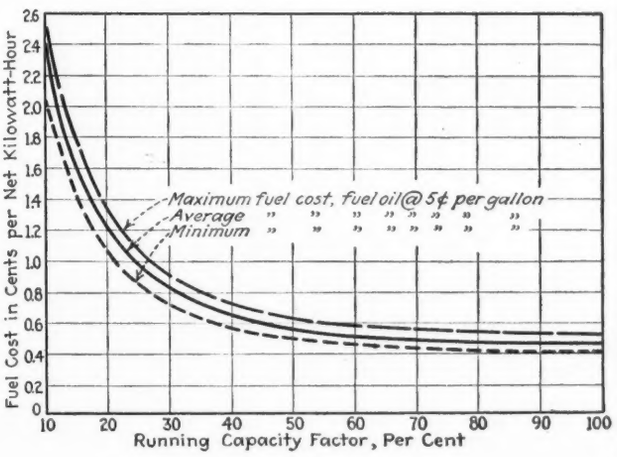

Fuel Cost in Cents per Net Kilowatt-Hour
Maximum fuel cost, fuel oil @ 5¢ per gallon
Average
Minimum
Running Capacity Factor, Per Cent

Fig. 3—Fuel cost based on five-cent oil

of lubricating oil economy points in Fig. 4 are straight lines, on the theory that the total oil consumption per hour of any engine remains a constant. This theory may not be absolutely correct, but it is near enough for a study of this kind.

The effect of the wide variation of economies upon lubricating oil cost is not much, because of the low level of cost under the most unfavorable conditions. From Fig. 5 it will be seen that lubricating-oil cost rarely exceeds one mill per net kilowatt-hour with lubricating oil at 50c. per gallon (the average price reported in the A.S.M.E. report is 52c.). Nevertheless there is no good reason why there should be such a divergence, and universally good operation would greatly narrow the spread of results.

There are too many variables involved in attendance cost to allow of an adequate graphical solution. Wages, load factors, and installed kilowatt per man enter into the question. The important thing in the A.S.M.E. data is that one man per shift is needed to take care of 2,000 kw. of installed capacity, or of any plant of lesser size. Naturally there are many plants in the report which are

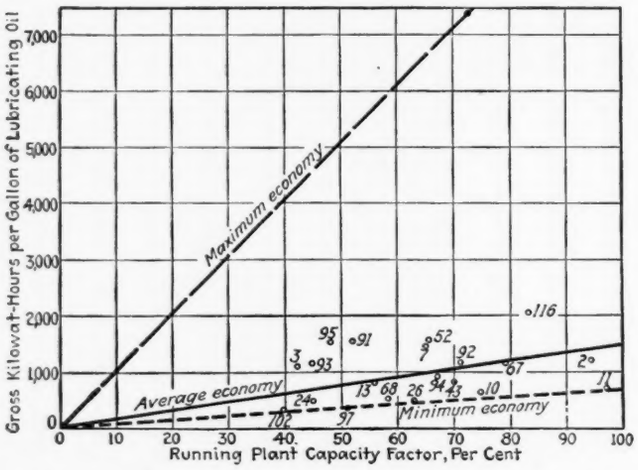


Fig. 4—The wide valuation in lubricating-oil consumption

overmanned by this standard. In this case, however, the criterion is not the average, but is what several plants of average load factors can do.

It would be interesting to analyze supply and repair costs to see what relation, if any, exists between fuel economy, lubrication economy, and repair costs. But it would be obviously unfair to attempt such an analysis at the present time. It is of interest to note that the weighted average supply-and-repair cost for all plants is 0.1449c. per net kilowatt-hour and the arithmetical average is 0.2444c. Into these averages go figures from plants that were overhauled in 1929, others that were overhauled in 1926, 1927, or 1928, or will be overhauled in 1930, 1931, or 1932. The averages, therefore, come as near as possible to the repair costs in a normal year for one plant. However, it is impossible to say from the figures just which plants in the report approached or experienced the periodic overhauling in 1929 or which went through it in 1928 or in previous years. It will be possible to decide these questions after three of four more annual reports are available, provided these same plants report each year, which is to be hoped for.

The same statement that it is too soon to judge data can be made in regard to much other information tabulated in the Diesel power cost report. Some day, it is thought, some conclusions can be reached about the effect

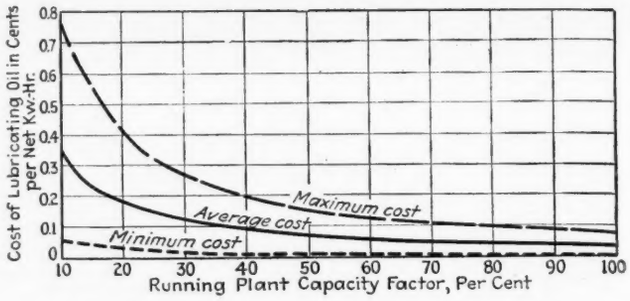


Fig. 5—Lubricating-oil costs

of various oil-purifying methods on lubricating-oil economy, about the effect of the kind of fuel oil and the use of air filters on liner wear and upkeep costs, and about the relative over-all efficiencies of various types of Diesel engines. A good start has been made in this direction in the setting up of the machinery for gathering and tabulating the pertinent data; but the work must be carried on for several years before the answers become evident.

Handling Petroleum Coke at the Lincoln Beerbower Station

By C. C. Plummer
Manager Chicago District, R. H. Beaumont Company

OIL-CRACKING stills produce a material known as petroleum carbon, or petroleum coke, which is finding an increasing use as a power plant fuel, especially in sections of the country in which refineries are common. Until recently this material was regarded as a waste byproduct, and great quantities of it were used for filling in low ground, and in some places it was simply discarded into waste piles. Its high thermal value and negligible ash content called attention to its possibilities as a boiler fuel, however, and today it is widely used both in power plants and for domestic purposes.

For some time the spread of its use was handicapped by the difficulties in preparing and handling. As the coke is formed in the still, it contains quantities of wire used to support the cable which is wound in spirals inside of the reaction chamber to facilitate removal of solid coke after the reaction is completed. These wires are embedded in the coke structure and consequently offer quite a hazard to any machinery with which the coke might be handled, particularly if this machinery is of the chain-and-bucket type. Other types of reaction chambers use drills or cutting tools for the removal of the coke, and this practice frequently results in the presence of broken cutting teeth among the lumps of coke.

The coke is burned in the power plant generally in pulverized form, so pulverizers as well as coke-handling machinery must be protected from damage. An example of how this fuel may be satisfactorily handled is found at the Lincoln Beerbower station of the Oklahoma Gas & Electric Company. A general description of this plant appeared in *Power* of March 11, 1930.

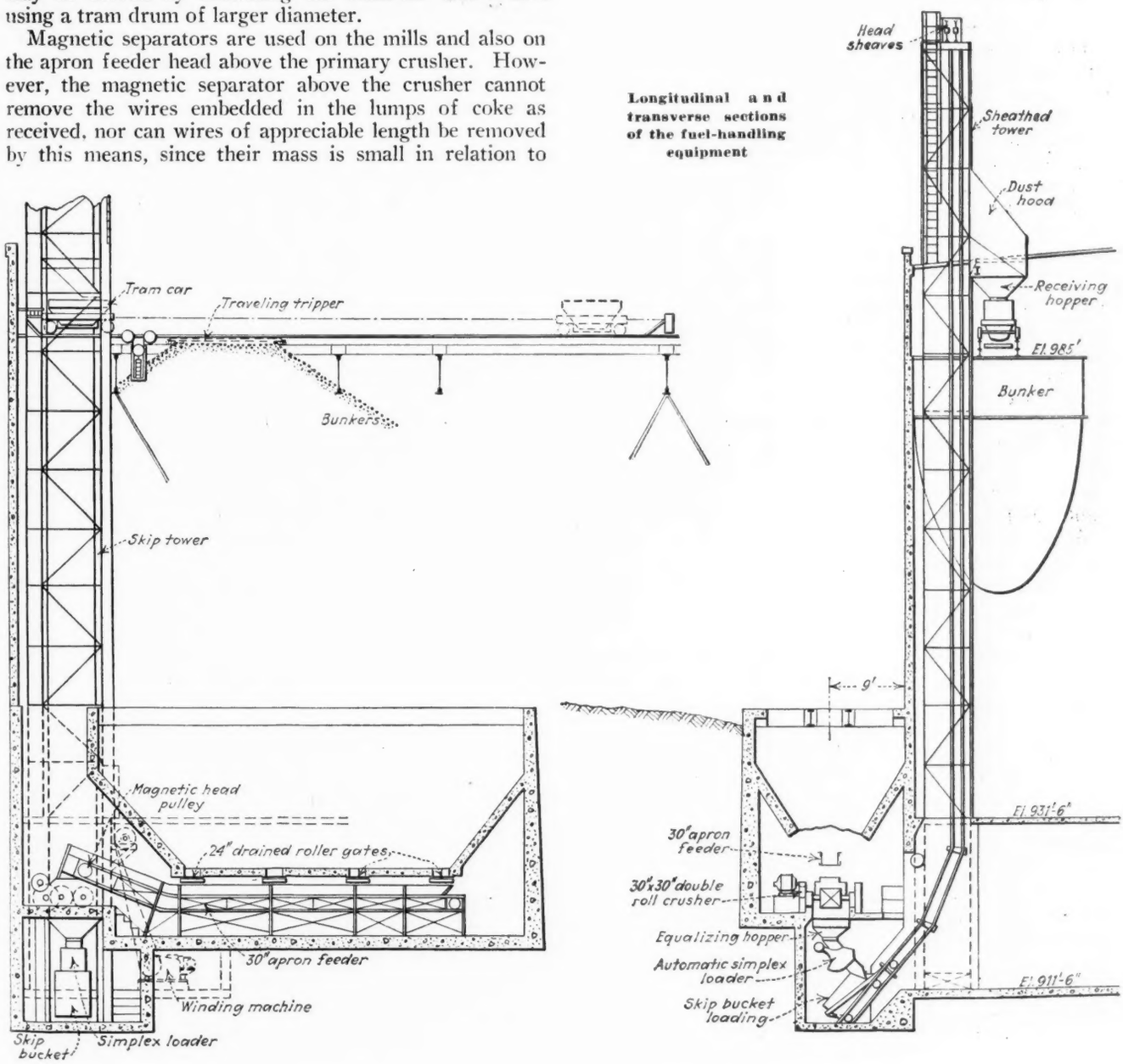
The petroleum coke is brought direct from the stills of a near-by refinery in railroad cars and discharged into a large dump hopper immediately under the railroad tracks. The hopper has four outlets fitted with 24-in.

square roller gates and collecting drains for the disposal of surface water that frequently is present in fuel after transit. One at a time these gates deliver to a slow-moving apron feeder, transferring the coke at the rate of 60 tons per hour to a large double-roll crusher that reduces lump coke to 1¼ in. maximum size. The crushed coke falls into a hopper to which is attached an automatic loader providing positive feed for a full automatic skip-tram. Essentially, the skip-tram consists of a vertical, continuous-cycle skip hoist with a horizontal distributing tram car designed to receive the skip-bucket discharge and transfer it to any desired point in the bunker over the pulverizers. This combination device is driven by steel cables from a single spur-geared electric winding machine having two drums keyed to a common shaft; one drum for alternately raising the skip bucket and its counterweight, the other for traversing the tram car in synchronism with the skip bucket. The tram car travels the entire length of the bunker regardless of its point of discharge, this point being determined by the location of a movable tripper which opens the tram-car discharge gate while the car is in motion. Future boilers may be served by extending the tram-car tracks and using a tram drum of larger diameter.

Magnetic separators are used on the mills and also on the apron feeder head above the primary crusher. However, the magnetic separator above the crusher cannot remove the wires embedded in the lumps of coke as received, nor can wires of appreciable length be removed by this means, since their mass is small in relation to that of the coke around them. At Beerbower station the fuel does not come in contact with any of the few rotating or moving parts of the system. To insure removal of all such wires at this plant, a 4-in. wire screen net was suspended immediately under the tram-car tripper, so that the attendant at the upper level can remove the wires at this point, just as the fuel is finally discharged into the bunker. The intermittent nature of the discharge of the tram car makes this action more feasible than it would be with a continuous discharge type of conveyor.

The relative ease with which petroleum coke is pulverized is apt to lead to a false conclusion that the primary crushing may be as readily performed. The fact is, that, owing to occasional variations in operating conditions in the cracking unit, the lumps as received are sometimes hard, or occasionally contain sufficient moisture and surface oil to be of a gummy or sticky nature. In selecting the primary crusher these facts should be considered. High-speed crushers frequently "plug" with this material, and if a double-roll crusher is used, a large safety factor is necessary for the heavy duty.

Longitudinal and transverse sections of the fuel-handling equipment



WELDING PIPE SYSTEMS for Steam Heating

The New Montgomery Ward Building in Chicago

By E. M. EVANS[1] and F. G. OUTCALT[2]

Welding is not merely a new method of fabrication to be applied to the usual piping layout of a heating system; it calls for a complete new approach to the problem and makes possible many novel methods of allowing for expansion, saving space, providing for drainage, etc. The heating job here described contains many practical suggestions.

THE new Montgomery Ward Building in Chicago is an eight-story, reinforced concrete structure about 326 ft. long and 160 ft. wide, occupying the block from Chicago Ave. to Superior St. and between Robert St. and the north branch of the Chicago River. The welded heating piping in this building is probably one of its most noteworthy features; not because a welded piping installation of this size is a novelty, but because the latest welding practices have been applied and pipe fittings especially designed for welded construction have been used.

No mention of welding had been made by the owner's architect and engineer, nor had any special arrangements been made for it, in the original plans and specifications, but the construction department of the Montgomery Ward Company had gained considerable experience with welded piping in older buildings at Forth Worth, Albany, Baltimore, Denver and elsewhere. Their decision to employ welded construction in the new Chicago building was based entirely upon satisfactory performance of previous installations. The contract, as finally awarded, called for the oxyacetylene welding of all steam piping over 1½ in. in diameter. Welding was used wherever possible, eliminating the maximum number of threaded joints, gaskets and mechanical connections of all kinds.

After years of operating experience with all kinds of piping systems, from those involving no welding at all to those with a large proportion welded, this company now has a system oxy-acetylene welded throughout, from boiler outlet to radiator supply branches, with screwed and flanged joints used only at connections to valves or special equipment. Charles E. Evans & Company, of 7 North May St., Chicago, the heating and piping firm which made this installation, had not had previous welding experience, but knowing that others were doing considerable work of this nature, and feeling that oxy-acetylene welding will be used even more in the future on account of its many advantages to owner and contractor, was anxious to make a start. Accordingly, the manufacturers of welding supplies and piping specialties and companies having long experience in welding were consulted and all available information as to procedure was obtained.

The necessary pipe, fittings, welding apparatus and materials were ordered. Alignment clamps and templates for fabricating special fittings were made. It was decided to do all necessary cutting on the job with the oxy-acetylene blowpipe; pipe was therefore bought in random lengths with beveled ends. This means of quickly and economically cutting pipe to any desired length on the job is an advantage that was not fully appreciated until actual work began and the inevitable changes in plans occurred.

The contracting company found several differences between oxwelded construction and that with which it had experience. In the mere detail of distribution, handling, and returning of cylinders it was found that some planning and organization were well worthwhile to eliminate lost time in obtaining materials. Distribution of cylinders to floors where they were required was handled on the general contractor's elevator, and a small but sufficient surplus was kept available on each floor where welding was being done. Hand trucks on which the cylinders were mounted, permitting of easy movement, were equipped with boxes for apparatus, rod, and accessories, so that each man had a complete, compact and

[1]Superintendent for Charles E. Evans and Company, Chicago.

[2]Resident development engineer, The Linde Air Products Company, Chicago.

conveniently portable unit. One man was assigned the duty of checking daily all material requirements for each succeeding day, collecting all empty cylinders, arranging for their return, and substituting the quantity of full cylinders needed.

Enough welders were available through the local steamfitters' union and as rapidly as conditions permitted the force was increased. In spite of the fact that this building was quite speedily constructed, there was no trouble in keeping up to schedule with the piping work.

Planning and laying out work for an all-welded job is somewhat different from that required for other methods, but much simpler. When an appreciation of welding methods and possibilities has been acquired, many advantages in addition to the mere substitution of welding for threads and flanges are realized.

This building contains approximately 50,000 sq.ft. of direct radiation, designed to operate on the Dunham differential system. Several unit heaters augment the direct radiation. The basement and first floors, which house the retail stores, are supplied with fresh warm air from a central blast system. Four 2,150-sq.ft. Kewanee low-pressure boilers supply steam at 2 to 5 lb. per square inch pressure, each boiler being connected to the main header by leads of 10-in. standard pipe.

The main header, shown in Fig. 1, consists of two 16-ft. lengths of 16-in. pipe welded together and blanked off at each end by pieces of ¾-in. flat plate welded in. The four 10-in. boiler leads are oxwelded throughout from the long-hub, forged-steel welding flange and tube turn at the boiler connection to the turn welded to the header at the other end. The small main at the left end of the header supplies unit heaters which operate on a vacuum system independent of the direct radiation. The 12-in. main taken off at an odd angle supplies the central blast system unit heaters for the basement and first floors, while the two 12-in. mains at the far end feed the main risers supplying the direct radiation. It will be noted from Fig. 1 that the safety-valve connections are also welded.

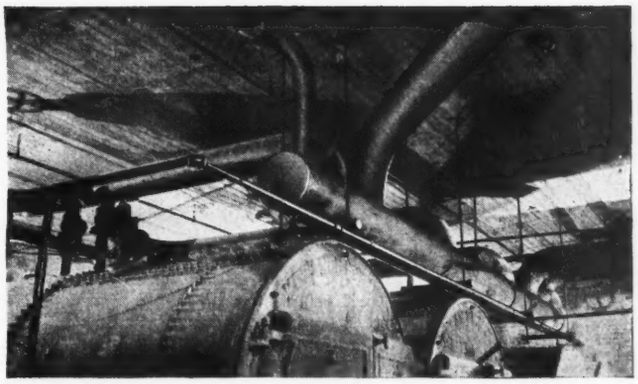


Fig. 1 (Above)—Main header and connections

Fig. 2 (Below)—Main header from top of boilers

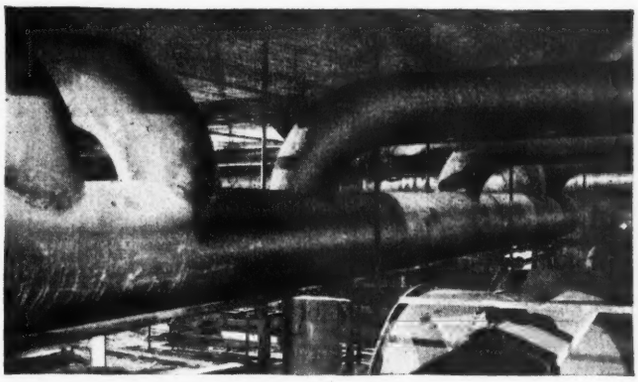


Fig. 3—Expansion loop in line from high-pressure boilers

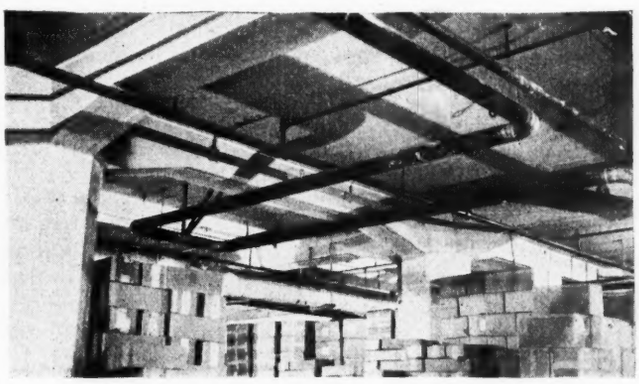
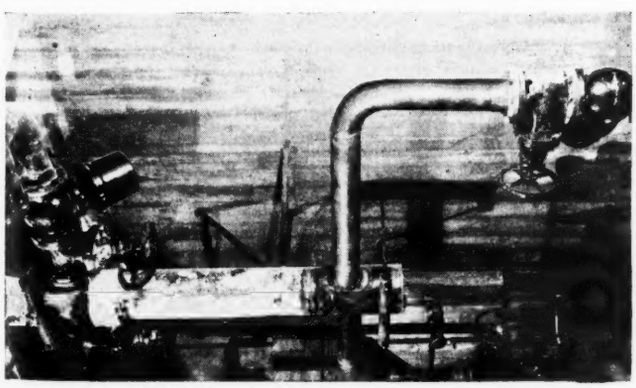


Fig. 4—Supply main and branches in fan room (looking up at ceiling)



The neatness and simplicity made possible by welded construction is clearly shown in Fig. 2. When the header is compared with one made up of flanged tees and elbows, the saving in weight, space, and material is evident, to say nothing of the greater ease of insulating the welded header and the permanent tightness which it affords. The entire header, including all connections, was fabricated on the floor and hoisted into position in one piece. The space saving is notable, the over-all vertical dimensions being about 34 in., which compares with a minimum of 53½ in. required for flanged construction. The weight of the oxwelded header is approximately 2,650 lb., while the weight of a similar header made up of flanged cast-iron fittings would be about 10,400 lb., nearly four times as great. A header of this type costs not over two-thirds as much as one made up of flanged fittings.

Another 6-in. outlet supplying water heaters and steam tables in the cafeteria was welded into the header after the accompanying photographs were taken and hence does not appear. The simplicity of making such a connection where oxy-acetylene equipment is available needs no explanation.

For supplying steam for water heating and cafeteria use during the summer, a 4-in. extra-heavy line was carried from the 150-lb. boiler plant in the old building on the north side of Chicago Ave., a distance of about 1,400 ft., to the boiler room of the new building, where a pressure reduction was made. Fig. 3 shows one of the four expansion loops installed in this line, offsets

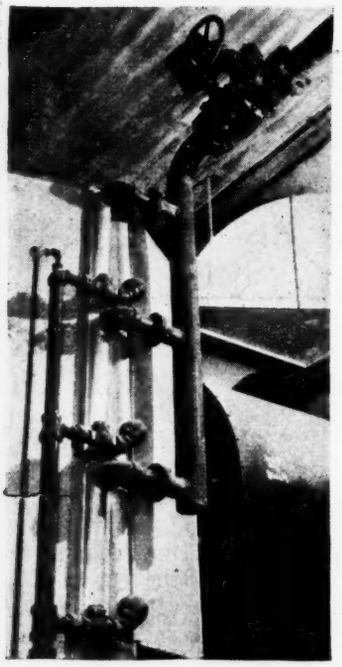


Fig. 5 (Left)—Details of heater connections

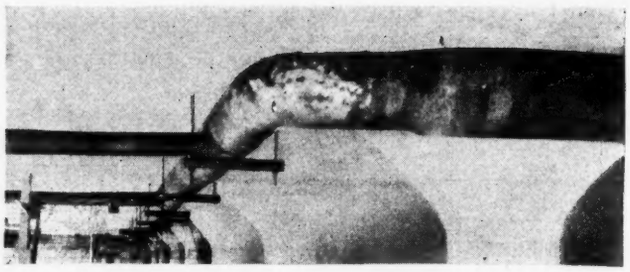


Fig. 8 (Right)—West zone distribution main—reduction from 12 in. to 10 in.

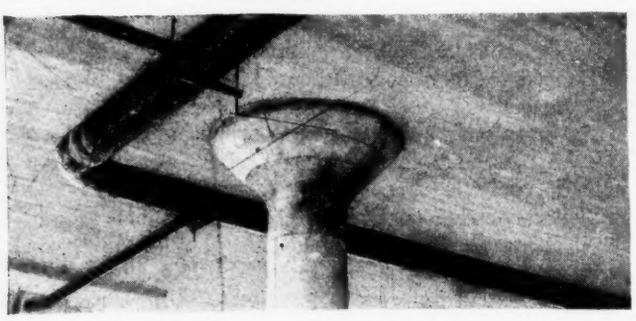
taking care of expansion at other points. This expansion loop was economically constructed from 16-ft. pieces of pipe and four tube turns. Practice followed in making this installation was to spread an expansion loop a sufficient amount, prior to connecting, so that it would be in a neutral position and not subject to any bending stresses when the line was at operating temperature, if the line was to be hot at all times. If the line was to be hot in winter and cold in summer, the loop was spread half this amount, so that it would be subject to but slight bending stress either when hot or when cold.

Tripod anchors and supports were readily constructed from small pieces of pipe welded to the main, flattened, bent, and oxy-acetylene pierced in the upper end for fastening to the ceiling with expansion bolts.

Fig. 4 shows a 12-in. header in the fan room supplying four 5-in. lines to York Superfin heaters. The use of tube turns and long-hub welding flanges is shown in this illustration and in Fig. 5, which shows one of the connections to a heating unit through a welded header. Fig. 4 also shows a tripod support of the type already mentioned.

Fig. 6—Mains leaving pipe shaft at fifth floor

Fig. 7—West zone distribution mains and branch connections



Two 12-in. mains pass vacuum reducing valves and leave the boiler room with an 80-in. radius bend, turn up the pipe shaft with tube turns and rise, with all joints welded, to the ceiling of the fifth floor. Turns bring them again horizontal as they emerge from the pipe shaft (Fig. 6) to supply the direct radiation in the east and west zones. Sweep bends were provided at this point for expansion of the horizontal portion.

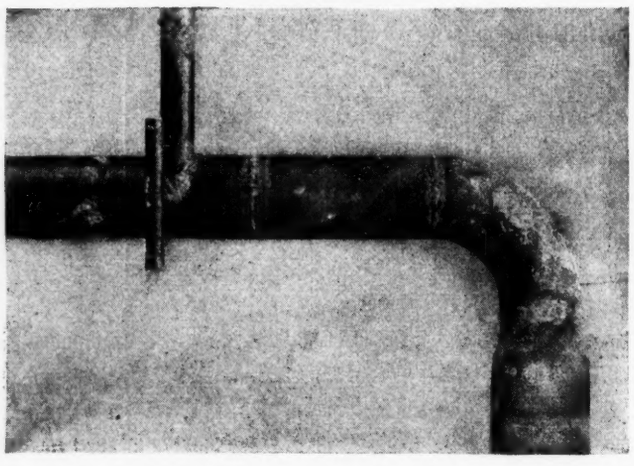
Some details of the piping on the fifth, or distribution floor, are shown in Fig. 7. Only the west zone, which is quite similar to the east zone, is illustrated. As originally planned the mains were to be exposed; for with only the 16½-in. space above the tops of the windows there is no room for an attic space of the usual proportions.

Since this floor was to be used for offices, it was decided that the pipes should be concealed if possible. The main and branches were successfully placed in a space of 14¾ in. after allowing for steel, lath and plaster for a hanging ceiling below the pipes. Since the largest main was 12 in. in diameter, leaving only about one inch, clearance above and below the pipe, it was necessary that runouts to the branch risers be welded into the main eccentrically, as shown in Fig. 7, to provide for drainage of condensate.

To insure accuracy, templates were used in making the cuts for these connections. These mains were fabricated on the floor in lengths of 40 to 80 ft. with short lengths of branches welded in. The sections were raised and hung temporarily a few inches below their final position by the use of long hanger rods. Space was thus provided for making the position welds, and the main was later raised to its permanent location by screwing up the hanger nuts, after which the surplus rod was cut off.

A tube turn and a forged reducer in the same section, typical of the construction used throughout, are shown

Fig. 9—Looking up at eccentric branch connection, tube-turn and reducer



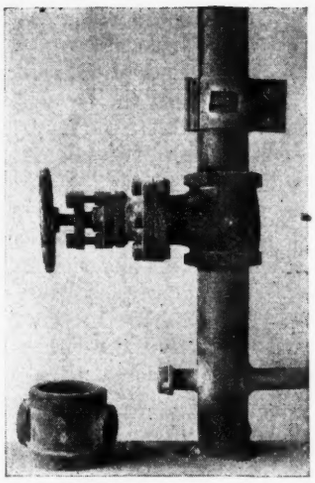


Fig. 10 (Left) — Typical riser at fifth floor with valve controlling flow below

Fig. 11 (Right) — Section of piping partially welded on floor

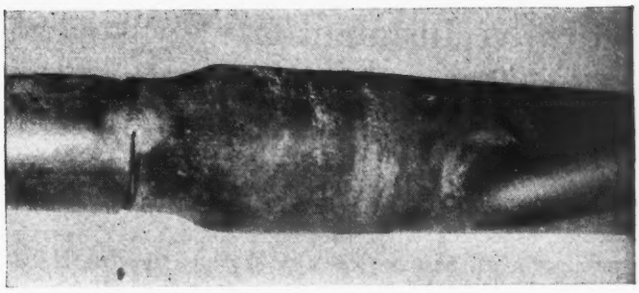
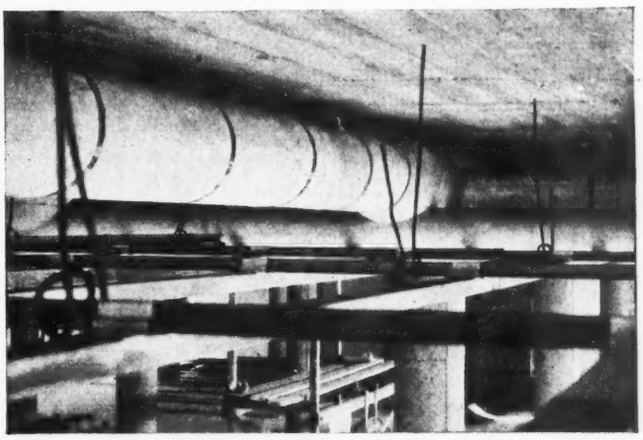


Fig. 12 (Below and Right) — Mains insulated. Ceiling steel in place before lathing



in Fig. 8. The nearer branch has been welded. The second is aligned and clamped ready for tacking. Figs. 7 and 8 show how close the piping is to the ceiling. Fig. 9 is a view looking straight up at the same details (Fig. 8), showing the branch taken off tangent to the bottom of the larger pipe.

Fig. 11 shows details of reducer and branch connections on the floor. The standard 45-deg. bevel and the spacing of the pipe ends to permit thorough fusion and to provide for contraction of the cooling weld metal can be plainly seen.

It will be noted that no attempt was made to use "swing" joints when taking off branches from the mains, as is often done when threaded construction is employed. These are not necessary where the branch is of sufficient length to permit some flexibility, especially when using oxwelded construction, which affords a joint as strong as the pipe itself. In providing for expansion of all long mains, U-bends were used.

Fig. 12 shows how the west zone mains looked after insulation was applied and ceiling steel was in place, but before lathing. A 6-in. main is shown in the foreground, and the reduction from the 8-in. main, after a branch has been taken off, is shown in about the center of the photograph. The latter main was installed level on account of the small amount of space available. All condensate is carried off by the branches.

For the down-feed risers maximum lengths that could be inserted through holes in the concrete floor were used, thus minimizing the required number of position welds. The line welds in the risers for the entire five floors were made before any branch connections for radiators or the final tie-in welds at the fifth floor were made. Consequently, each riser could be turned and welding could be done in a convenient position in spite of the fact that the risers were close to the wall.

Fig. 10 shows a typical riser at the fifth floor, with a valve controlling the floors below. Radiator branches were welded in and capped to keep threads and pipe clean until they were continued with screwed joints to the radiators. The use of a screwed cross was thus eliminated at each floor, and in several cases close connections, which would have required two tees or other cumbersome fittings, were greatly simplified by cutting into the riser and welding branches in at any desired angle.

Pieces of $\frac{1}{2}$-in round bar, cut to proper lengths and welded to the pipe at intervals to preserve the desired grade, were found to be a simple means of preventing sags and misalignment. Since these were welded on after the walls had been painted, a sheet of asbestos board was placed behind the pipe to protect finished surfaces from the heat.

Fig. 13 shows an offset at the ground floor level in the 5-in. unit heater supply riser, made necessary by the difference in thickness of the basement walls and the curtain walls above. This offset was fabricated on the job with two 45-deg. tube turns before it was welded into position.

Before steam was available, a hydrostatic test at 50 lb. per square inch pressure of all piping that was to be permanently concealed behind plaster or the hanging ceiling on the fifth floor was made, and all joints were carefully inspected.

Fig. 13 — Offset at ground floor level

This piping system is now in operation. Its efficiency exceeds expectations, and detailed studies of the efficiency of flow through the system are contemplated. This investigation, if made, is expected to substantiate the contention that welded constructions offers less resistance to flow than other types.

Defective Installation Causes Power Feeder Failures

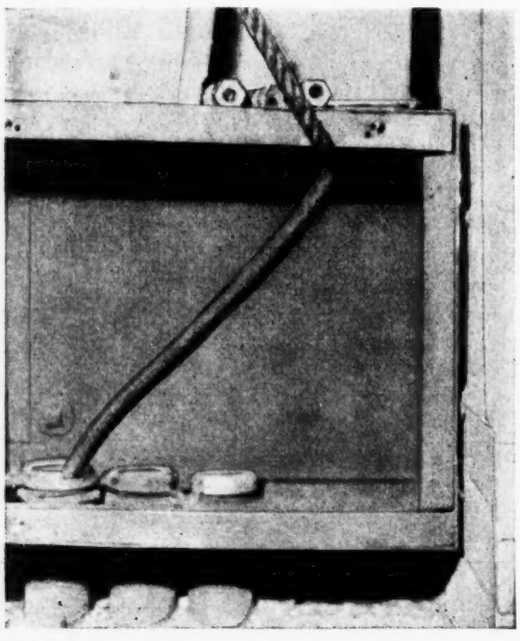
By Albert A. A. Rodriques
New York City

RARELY do feeders in a new electrical installation fail, especially when properly installed and if a reasonable amount of overload capacity has been provided. Unfavorable conditions existing during installation of feeders cannot remedy themselves and are likely to become worse. A case in point is that where neglect of a small detail during installation caused the grounding of two elevator feeders, suspended elevator service, and required renewal of the feeders. The customary hardwood suspension bushing and drop-back wedge was not used at the upper end of the conduit in the pull box. In this box the wires were offset about 40 deg. when passing from one conduit to another, as in the figure. The downward pull of the feeders pressed them hard against the conduit bushing, and destroyed the insulation.

The pull box in which the failure occurred was on the top floor of the building, and the box below it was three floors down, a distance of approximately 50 ft. At the lower box the damaged feeders were cut and spliced with a straight-through pair of conductors, run to the elevator panel on the roof. Had the original job been done correctly at first, time, labor, and expense would have been saved.

The value of a general, systematic, and periodic inspection and test of feeders as far as eye and testing devices will permit cannot be over-emphasized. A 30-min. repair or maintenance job attended to at once, may prevent a 30-hr. or longer one in the future.

Strange circumstances accompanied the failure of two of four lead-incased 240-volt vertical feeders, connected to the busbars of a power panel. A test showed the feeders were dead and the fuses on the main switchboard had blown. When the lower section of the distributing panel was removed it disclosed the feeders hanging clear of their lugs and grounded. This occurred even though the feeders were wedged and clamped in the panel, and also wedged in the pull box three floors below, where the trouble occurred. The wedges at both locations had apparently dried out and shrunk, and, although the iron clamp held on the top end of the conductors, their weight was sufficient to cause the lead covering to strip off.



The insulation failed on the conductors where they bend over the end of the conduit

To repair the damaged feeders a portion of the bottom of the panel had to be cut out and a 5-in. nipple removed from the conduit carrying the more damaged feeder, 6 in. of which had to be cut off after it had been pulled up by a chain-block and secured with clamps and wedges. After the lugs were replaced a piece of copper bar equivalent to the cross-section of the feeder was used to compensate for the amount that was cut from the feeder. Damage to the second feeder was less severe; after it had been drawn up, wedged, and the lug replaced, it was taped and given a coat of insulating paint.

A Day at Golpa Zschornewitz

[The following travelog letter from *Power's* editor was written 4,700 feet aboveground. He was traveling by plane from Berlin to Copenhagen.]

By Ely C. Hutchinson

WE LEFT the hotel at eight by auto and after two and a half hours' ride at fifty to sixty miles per hour, through beautiful country, arrived at the plant.

The Golpa Zschornewitz station is one of seven in the system of Reichselektrowerke (the Electric Power Corporation) of Germany. Their total capacity is in the neighborhood of 730,000 kw., serving the provinces of Upper and Lower Silesia, of Brandenburg, Saxony, Brunswick and Anhalt. The population of these districts is about 20,000,000.

It is the opinion of engineers that the Golpa boiler room is one of the best in Germany. The magnitude of the layout is impressive. Cleanliness and the absence of hand labor are marked.

Seven boiler rooms contain, all told, 100 boilers, Babcock & Wilcox type, with a total heating surface of 657,700 sq.ft. Steam is generated at 228 lb. and 732 deg. F. The feed temperature is 239 deg., and the rate of steam generation 12.3 lb. per square foot of boiler heating surface. Economizers and air preheaters are used.

Brown coal or lignite containing about 55 per cent moisture, 2 per cent sulphur, and 9 per cent ash is mined two miles away and brought in by electric locomotives hauling ten or twelve 20-ton cars. Movement of the coal is automatic thereafter.

The ash-handling system is hydraulic. All ash is piped back to the open pit of the coal mine, where it is used as filler. Clinker is separated and broken up before being introduced into the pipe system.

One man in the switchboard room controls by push button the draft, discharge gas temperature and coal feed to the entire 100 boilers. This is all done from a board about 25 ft. long.

Because of the low pressure, steam is carried to the turbines in double pipes rather than one pipe of a larger diameter.

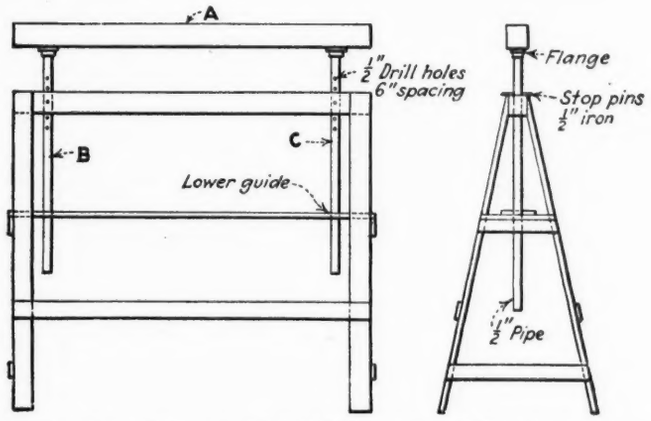
There are sixteen turbines in the station, with a total capacity of 440,000 kw. The last two installed are rated at 100,000 kva. each at 1,500 r.p.m. and 192 lb. steam pressure. Condensing water is pumped to cooling towers, of which there are eighteen of wood and three of concrete. A vacuum of 28½ in. is claimed to be average.

. . . RIGHT OUT OF THE PLANT . . .

Adjustable Platform Horse

THE platform horse shown in the illustration has an adjustable feature that makes it more convenient and time-saving than the ordinary horse. This feature also eliminates the use of blocking to gain additional height, which also makes it much safer to use.

Built like an ordinary horse, it is provided with an additional cross piece *A* which will slide up by means of pipes *B* and *C* screwed to the cross piece with flanges.



Top bar of horse is adjustable by means of pipe supports

These pipes should be about 1½ in. They are drilled with a series of holes spaced 6 in. apart. Stop pins of iron or steel are passed through the holes and brought to rest on the top cross-member.

The pipes pass through suitable guide holes properly located in a crossboard about midway from floor to the top of the horse. It is possible for the man using this horse to adjust the height to suit the job he is working on.

Syracuse, N. Y. H. L. WHEELER.

Some Studies on Economics in Steam Heating Plants

SOME TIME AGO I had the following problem to solve: A plant sent in its year's operation log sheets with a request to submit recommendations as to how to secure four ideals every power plant or heating plant strives for, namely, increased efficiency, decreased operating costs, decreasing maintenance, and guaranteed continuous operation. The last to be obtained at no sacrifice in any of the first three items.

This plant was equipped with two 11,000-sq.ft. single-drum, water-tube boilers with underfeed stokers and served by a 6-ft. diameter brick stack 150 ft. high. Considerable boiler tube replacement, and a great increase in fuel consumption, was reported, especially during the heating season. There was available auxiliaries of sufficient capacity to take care of additional boilers. The plant was eight years old. There was no basement under the boiler-room floor. There was available a floor space of 20x45 ft. and head room of 28 ft.

The log covered a week-by-week coal and water consumption record, as well as giving the average temperature in boiler room, flue gas, and feed water; also the boiler-draft pressure and the average heating return-line pressure.

The first thing checked from the data given was the stack draft and fuel consumption. In the log as presented, the average draft was 0.9 in. of water for the month of January through June, and the average through July to Sept. 15 was 0.34 in. The coal used was bituminous of 14,400 B.t.u. heating value and an ash content of 10 per cent.

Kent's formula was used for checking up the size of the stack. For a boiler of 10,230 sq.ft., based on ½ lb. of coal burned per square foot of heating surface, the size of stack required is given as 72x150 ft., and for 21,300 sq.ft. a stack of 102 in. diameter and 150 ft. high would be required (see Kent, 10th edition, page 1023). So the stack, as put in, was small for the rated boiler capacity if worked to the rate of burning ½ lb. of coal per square foot of boiler heating surface.

For checking up on draft and rate of combustion, reference was made to Helios, 1920 edition. Figure 97 on page 186 gives the following by interpolation:

DRAFT REQUIRED FOR BITUMINOUS COAL

Draft, inches of water.....	0.15	0.17	0.20	0.22	0.28	0.30	0.37	0.43
Rate of combustion (pounds per square foot of grate surface).....	18	20	22	24	30	30	34	38

From Fig. 98, page 197, interpolations for a two-pass boiler are given as:

Draft.....	0.04	0.1	0.12	0.17	0.24	0.37	0.7
Per cent of rating.....	40	60	80	100	120	150	200

It was found that the maximum draft the stack could give was 0.67 with one boiler operated at 130 per cent, and velocity of gases, based on flue temperature of 532 deg., was 28.3 ft. a second.

Upon estimating the proper size of stack for the two boilers installed on a total of 20,200 sq.ft. of boiler heating surface, it was found that a stack approximately 8 ft. in diameter was necessary. This calculation was made to determine if the present stack could be used without forced draft to get boiler rating. That was found to be possible.

On the log the draft showed some forcing above the possible natural draft of 0.67 in. but running even with

one boiler at 20 to 30 per cent of rating in summer months is a poor economy, as this load could be taken care of by a 5,000 sq.ft. boiler.

In checking the draft requirements for underfeed stokers reference was made to page 232 of the handbook on "Finding and Stopping Waste in Modern Boiler Plants" (Cochrane Corp. 1928). For using underfeed stokers bituminous coal of 14,000 B.t.u. the minimum combustion rate is given as 21 lb. per square foot of grate surface. If we take 25 lb. coal per square foot of grate area, the necessary draft is 1.9 in. of water, and if we allow 1 in. for duct and damper loss the draft should be 2.9 inches.

Now, if we assumed the grate area to be six times the area of the stack, we would get a grate area for a 6-ft. diameter stack of 169.62, or, 170 sq.ft., which was the grate area of the boilers. The consumption, if based on this grate area as computed from the log sheet, showed a combustion rate of 5 to 7 lb. per square foot of grate area. This indicated that the boilers were operating at less than 25 per cent of normal load.

An inspection of curve *H* on page 62 of the handbook showed that the best rate of combustion is 25 lb. per square foot of grate area for bituminous coal. When the rate of combustion gets down to 10 lb. the efficiency of the boiler drops to 65 per cent, and at 5 lb. per square foot its efficiency drops to 50 per cent.

This would indicate that a rate of combustion of 7 lb. per square foot of grate, using underfeed stokers, entails great waste, and it would seem that underfeed stokers are not advisable where boilers are not forced.

During the 32-week heating season the total boiler hours amounted to 9,266; the actual evaporation per pound of coal according to the log sheets, 9.8; and the boiler rating in per cent of normal, 42.1. The corresponding figures for the 2-week off-heating season were 3,408 boiler hours, 9.36 lb., 26.7 per cent of rating.

Washington, D. C. ROBERT HUGHES.

The Cold-Water Test on Boilers

I HAVE READ with interest the editorial entitled "The Cold-Water Test on Boilers" which appeared in the June 17 number, and should like to express my agreement with the author. I have always held strong views on the subject of hydraulic testing. Several years ago *Power* published an article of mine on this subject. I cannot help but feel that, in this day, hydraulic testing for any purpose other than that of discovering defective workmanship, either in new boilers or in repaired boilers, is poor practice. The hydrostatic test, at any time, unless accompanied by exhaustive and careful measurement, cannot divulge anything beyond the fact of whether there are leaks or no leaks. Hydrostatic testing in the case of old boilers may be, and has been on numerous occasions, the cause of serious subsequent accidents. In the case of a new boiler, with a factor of safety of from 4½ to 5, the testing of a boiler to double its proposed working pressure, practically means a test to the elastic limit of the metal. After this boiler has been working a few years, subject to all the stresses of operation, and is then again tested to double its working pressure, it is highly probable that the then elastic limit of the material is exceeded.

Another point is the method in which hydraulic testing is applied in a great many cases by operators. The ordinary reciprocating boiler-feed pump is used to put the pressure on, with the result that violent fluctuations of pressure, of from 15 to 30 lb. at times, take place, which virtually corresponds to the blows of a heavy hammer. A great many boiler inspectors are also guilty of misusing hydrostatic tests.

In my opinion, hydrostatic testing of a boiler beyond normal working pressure should never be performed by anyone but an expert who is fully cognizant of the potential damage he may inflict and who takes proper precautions to prevent this. Furthermore, hydrostatic testing to full working pressure is all that is necessary to disclose any leaks which may have occurred through ordinary operation of the boiler. And hydrostatic testing to double the working pressure cannot do any more than this, and may easily result in permanent distortion and consequent weakening of the unit. There seems to be a vast amount of misunderstanding relative to hydrostatic tests, and a fixed idea in the minds of a great many men who ought to know better is that the hydrostatic test governs the working pressure, instead of the working pressure governing the hydrostatic test.

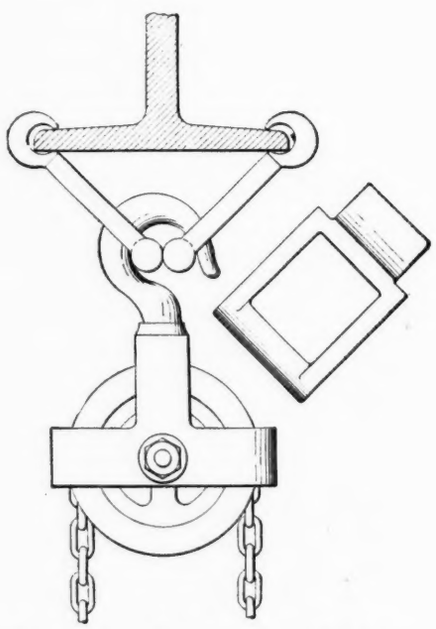
T. H. FENNER, *Manager Engineering Dept.*,
General Accident Assurance Company of Canada.
Toronto, Ontario.

Convenient Means for Anchoring Chain Hoist to I-Beam

WHEN NECESSARY to anchor or attach a chain hoist to an I-beam a convenient expedient can be resorted to as shown by the illustration. Get two links out of a large detachable-link industrial-conveyor chain such as is commonly found around any plant where material or power is transferred by this type of link chain. Next place them as shown in the sketch with regard to the I-beam and lift hook of the hoist.

These links will prove so handy for this purpose that they will be kept with the chain hoist as regular equipment for such work. W. S. WHITING, JR.

Butler, Tenn.

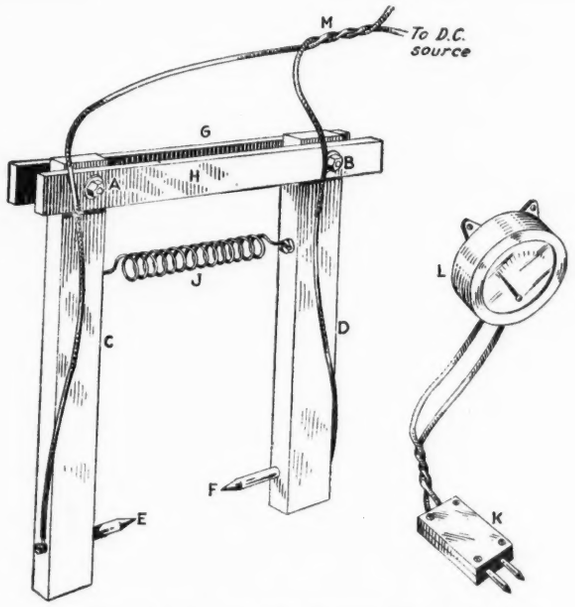


Hoist suspended from beam by chain links

Armature-Testing Device

THE DESCRIPTION of a device for testing wave-wound armatures in the April 8 number recalled a similar idea that I have used for some time. The accompanying sketch shows all details. The device has the advantage of instantly being available for use on commutators of any size within its capacity without requiring any adjustment.

Direct current is secured though drop cord *M*, a suitable resistor being connected in series with the armature on test. The arms *C* and *D*, of $\frac{1}{2}$x1$\frac{1}{2}$x12 in. fiber,



Wave-wound armature and bar-to-bar testing device

can be spread so the points *E* and *F*, which are $\frac{3}{16}$x4 in. bolts sharpened at one end, make contact on the commutator. The spring *J* holds the arms in place. The bars *G* and *H* are made of $\frac{1}{4}$x1x9 in. fiber.

The two contact points *K* of the small testing device shown at the right are used for a bar-to-bar test. Any abnormal condition in any of the coils will show a deflection on the ammeter. Open circuits show a high deflection. Shorted or partly shorted coils show a deflection that is less than normal. Reversed coils show a deflection in the opposite direction from that of a normal coil.

CHARLES A. PETERSON.

Cold Spring, Minn.

Adapting Engines to Higher Pressures

IN THE answers given to the question, "Can a Uniflow Engine Designed for 150 Lb. Be Operated With Steam at 300 Lb. and 100 Deg. Superheat?" which appeared some time ago, it would seem that one important factor, that of bearing pressure, was not considered.

In my opinion, the change should not be made without providing certain compensations. It is customary for the builder, when informed of steam conditions, to give the right size cylinder for the required horsepower rating. He figures the throttle pressure on the piston for the pin dimensions. It is not correct to figure it this way, because the inertia forces absorb a considerable part of the pressure when the engine is running, so the pressures can never reach these figures.

The important thing, in fact, necessary to secure good wearing qualities and an engine that will run well with little attention, is to see that the pin pressures for projected area, speaking especially of high-speed reciprocating engines, is, for crosshead pins, 1,200 lb., and for crankpins, 850 lb.

One should not attempt to simply raise the steam pressure without expecting to run into trouble, which the builder can, if he will, amplify.

Coxsackie, N. Y. LANCELOT COPLESTON.

Is It Safe to Blow Down Water Walls?

I SHOULD LIKE to add to the discussions that have appeared on blowing down water walls. Personally, I never did like the idea of blowing down the water walls of our boilers, but I found that the side walls had to be blown down, as all of the sludge rested on the bends of the tubes. In fact, I just caught the side walls in time to prevent burning of the tubes. That was over twelve months ago, and since then we have blown down while under load. I brought up the question of the blowing down interfering with the circulation, while the boilers were under construction, but we had to test it for ourselves.

We have two 10,000-sq.ft. boilers with side and back water wall. These boilers carry 350 lb. pressure and the rating during the winter months is around 280 to 300 per cent of normal. During the night the load drops to around 220 per cent. So far we have not experienced any trouble from blowing down the walls with the boiler in service, but at the same time we should like to operate without it if possible.

We use as much as 180 lb. of sodium phosphate each 24 hr. on one boiler to overcome scale troubles, and in addition we have to blow down to clear the sludge.

P. JONES, *Chief Engineer,*

Montreal, Canada. C. N. R. Shops.

Pound in Diesel Cylinder

THE answer given in the June 10 number to an inquiry regarding pound in a Diesel cylinder on the upper dead center of the exhaust stroke was, in the main, correct regarding the cause—that is, no compression to cushion the slack in the bearing. But the answer gave the wrong bearing, for the pound was in piston-pin bearing.

Because of its position, the piston-pin bearing is often neglected, and the wear soon reaches a point where the piston jump is taken up with a noticeable knock. Taking up a crankpin bearing is, of course, futile in that case.

To test the piston pin, place the piston on its lower dead center and set a timber across the crankcase main bearing webs. By using a heavy-duty lever jack between the piston and timber, the bearing slack can be readily determined, either with a scale or a dial indicator.

FRED. B. MAES,

Redwood Falls Light & Power Co.

Redwood Falls, Minn.

From Among Readers' Problems

Conducted by
L. H. MORRISON

WETTING COAL—*Is it advisable to wet coal before putting it into the hopper of a chain-grate stoker? What causes the coal to turn to coke near the back of the stoker?* R.E.R.

If the coal has much slack it is advisable to wet it down so that the slack does not drop through the grate.

The "coking" action is probably due to the fact that the air velocity at the rear of the stoker is so high that the unburnt coal fuses. This can be corrected by building a rear arch to bring the air toward the front.

PURGING AMMONIA CONDENSER—*Is it possible to remove all foreign gases by purging an ammonia condenser?* A.L.T.

It is not; even though the contents of the condenser are reduced to a low temperature some ammonia still will be in a vaporous condition. This is because the pressure exerted by a mixture of gases is made up of the sum of the pressures exerted by each gas. Even though the condenser pressure be kept high, say 175 lb. gage (190 lb. abs.) and the temperature reduced to 60 deg., part of this pressure will be due to the ammonia vapor. At 60 deg. F. the saturated or boiling temperature of ammonia is 92 lb. gage (107 lb. abs.). Then of the gaseous contents in the condenser $\frac{107}{190}$ of the volume is made up of ammonia and the remainder $\frac{83}{190}$ is foreign gas. The best method is to use some one of the several purgers that reduces the gas temperature before discharging the air.

PUMPS USING STEAM EXPANSIVELY—*How can steam be used expansively for operation of a pump?* H.H.C.

For operation of piston pumps the power must be sufficient to overcome the discharge pressure at every point of the stroke. Hence, to use the steam expansivley in direct-acting pumps there must be pistons in high- and low-pressure cylinders, on the same or connected piston rods, with high- and low-pressure units acting simultaneously for movement of the water piston in the same direction.

Another method of using the steam expansively is to employ a compound engine with a crank and a flywheel for storing energy during that part of the stroke when the steam pressure is in excess of the pump resistance, and for restoring the surplus energy to that portion of the stroke where the expansion force of the steam would not be sufficient to overcome the pump resistance. Other methods that have been used for effecting temporary storage and restoration of energy are the compressing and re-expansion of air, raising and falling of weights, and distortion and recovery of springs.

RELATION BETWEEN A. P. I. GRAVITY AND WEIGHT—*What is the relation between the specific gravity of the A. P. I. oil table and the weight per gallon.* P.M.

The A. P. I. gravity is a modification of the Baumé scale. Its relation to the weight of the oil per gallon and the heat content is given in the table:

Gravity		Density	Total heat of combustion at constant volume, Q_v			Net heat of combustion at constant pressure, Q_p			Degrees A. P. I. at 60° F.
Degrees A. P. I. at 60° F.	Specific at 60°/60° F.	Pounds per gallon	Cal./g	Btu./lb.	Btu./gal.	Cal./g	Btu./lb.	Btu./gal.	
10	1.0000	8.337	10,300	18,540	154,600	9,740	17,540	146,200	10
11	.9930	8.279	10,330	18,590	153,900	9,770	17,580	145,600	11
12	.9861	8.221	10,360	18,640	153,300	9,790	17,620	144,900	12
13	.9792	8.164	10,390	18,690	152,600	9,810	17,670	144,200	13
14	.9725	8.108	10,410	18,740	152,000	9,840	17,710	143,600	14
15	.9659	8.053	10,440	18,790	151,300	9,860	17,750	142,900	15
16	.9593	7.998	10,470	18,840	150,700	9,880	17,790	142,300	16
17	.9529	7.944	10,490	18,890	150,000	9,900	17,820	141,600	17
18	.9465	7.891	10,520	18,930	149,400	9,920	17,860	140,900	18
19	.9402	7.839	10,540	18,980	148,800	9,940	17,900	140,300	19
20	.9340	7.787	10,570	19,020	148,100	9,960	17,930	139,600	20
21	.9279	7.736	10,590	19,060	147,500	9,980	17,960	139,000	21
22	.9218	7.686	10,620	19,110	146,800	10,000	18,000	138,300	22
23	.9159	7.636	10,640	19,150	146,200	10,020	18,030	137,700	23
24	.9100	7.587	10,660	19,190	145,600	10,040	18,070	137,100	24
25	.9042	7.538	10,680	19,230	145,000	10,050	18,100	136,400	25
26	.8984	7.490	10,710	19,270	144,300	10,070	18,130	135,800	26
27	.8927	7.443	10,730	19,310	143,700	10,090	18,160	135,200	27
28	.8871	7.396	10,750	19,350	143,100	10,110	18,190	134,600	28
29	.8816	7.350	10,770	19,380	142,500	10,120	18,220	133,900	29
30	.8762	7.305	10,790	19,420	141,800	10,140	18,250	133,300	30
31	.8708	7.260	10,810	19,450	141,200	10,150	18,280	132,700	31
32	.8654	7.215	10,830	19,490	140,600	10,170	18,310	132,100	32
33	.8602	7.171	10,850	19,520	140,000	10,180	18,330	131,500	33
34	.8550	7.128	10,860	19,560	139,400	10,200	18,360	130,900	34
35	.8498	7.085	10,880	19,590	138,800	10,210	18,390	130,300	35
36	.8448	7.043	10,900	19,620	138,200	10,230	18,410	129,700	36
37	.8398	7.001	10,920	19,650	137,600	10,240	18,430	129,100	37
38	.8348	6.960	10,940	19,680	137,000	10,260	18,460	128,500	38
39	.8299	6.920	10,950	19,720	136,400	10,270	18,480	127,900	39
40	.8251	6.879	10,970	19,750	135,800	10,280	18,510	127,300	40
41	.8203	6.839	10,990	19,780	135,200	10,300	18,530	126,700	41
42	.8155	6.799	11,000	19,810	134,700	10,310	18,560	126,200	42
43	.8109	6.760	11,020	19,830	134,100	10,320	18,580	125,600	43
44	.8063	6.722	11,030	19,860	133,500	10,330	18,600	125,000	44
45	.8017	6.684	11,050	19,890	132,900	10,340	18,620	124,400	45
46	.7972	6.646	11,070	19,920	132,400	10,360	18,640	123,900	46
47	.7927	6.609	11,080	19,940	131,900	10,370	18,660	123,300	47
48	.7883	6.572	11,100	19,970	131,200	10,380	18,680	122,800	48
49	.7839	6.536	11,110	20,000	130,700	10,390	18,700	122,200	49

CHANGE OF PISTON CLEARANCE FROM KEYING UP CONNECTING ROD—*How is the piston clearance of an engine affected by keying up a solid-end connecting rod that has the keys between the pins?* R.W.

When the keys are between the crank-pin and the cross-head pin, keying up has the effect of lengthening the distance between the pins, thereby causing the piston in its stroke to be carried nearer the head end of the cylinder. Hence there will be reduction of piston clearance in the head end and increase of the clearance in the crank end.

PULSATIONS IN AIR TANK—*Can you tell me how I can stop a ringing sound in a compressor tank when the tank is being filled? The tank holds about as much as a 40-gal. range boiler.* V.M.

The ringing noise is due to resonance, on which a discussion appears on the opposite page.

To eliminate this trouble you should either lengthen or shorten the pipe line between the compressor and tank. If this is difficult you may find that a short length, of, say, 6-in. pipe connected into the line by a tee and capped to form an air chamber may so alter the pressure waves that the resonance disappears.

PREVIOUS QUESTION

Discussed by Readers

THE QUESTION

OUR feed-water lines are of the loop, or two header, design, supplied by a duplex steam-driven pump. If we feed through one header severe water-hammer occurs, which is absent when the second header is used. What is the cause? F.R.

THE WATER-HAMMER which occurs when the first header is used is probably caused by some interference with the water flow in either the header itself or the connecting piping. It does not seem likely that the header itself can be at fault, unless some alteration has been made. If the connecting piping contains any elbow or construction that interferes with the water flow, water-hammer will result.

The whole header should be examined. It is probable that the water flow is not nearly so direct as in the second header, this causing the flow to be more unsteady.

The fitting of an air vessel on the first header should give an improvement by preventing the bad effects of percussive action as the water is started and stopped at each stroke of the pump. This action cannot be prevented with a duplex steam pump owing to its reciprocating motion. W. E. WARNER.

London, England.

FROM the description of the trouble, it looks as if the discharge line is just the correct length, and the pump is timed just right, to set up resonance.

Reciprocating pumps set up primary pressure impulses in the discharge line, which travel along the discharge line with the same speed that sound would travel in the liquid in the pipe. The velocity of these impulses is independent of the speed of the pump, but the frequency of their generation is the same as that of the pump strokes.

If the discharge line is long enough and there are no sharp bends or valve gates to reflect them back, these primary pressure impulses are destroyed by internal and surface friction. If there are points of reflection, they will be reflected, with some loss, and may combine with newly generated primary waves, to set up stationary pressure waves.

If the pump strokes are timed just right and the length of the discharge line is just right, between the pump and the point of reflection, the peaks of primary and reflected waves may combine in maximum phase of the same sign. This is called the resonance condition, or water-hammer.

There are at least four remedies for this condition, and the enumeration of them may suggest others: (1) Change the length of the discharge header; (2) change the speed of the feed pump; (3) install an air chamber; or (4) install on the pump a non-pulsating valve gear such as is made by an engineering concern in California. R. A. DICKSON.

Caldwell, N. J.

CAUSE of severe water-hammer in the loop feed-water lines will, I think, be found in leaky check or stop feed-water valves, which allows hot water or steam to escape from the active to the inactive side. As the water resting in the dead header cools, water-hammer will invariably result from leakage.

I suggest that the check and stop feed-water valves be examined for leakage and, at a convenient time, a ½- or ¾-in. globe valve be placed at the lowest point of the header that is cut out. While operating from one header only, and with this drain valve open on the dead header, there will be an entire absence of water-hammer.

From time to time I have experienced this trouble in various plants, and without exception the annoyance was remedied by the method outlined.

THOS. MIDDLETON.

Vancouver, B. C.

A Question for Our Readers

IN CHANGING from pulverized coal to natural gas, can we expect that our superheaters, which are of the convection type, will show too high a superheat? The highest superheat we can carry, on account of the engines, is 100 deg. F., with steam at 200 pounds. A.C.B.

Suitable answers from readers will be paid for and published in the Sept. 9 number

ASSUMING the change to this troublesome header is made while the feed water is very hot and the header is cold, there is a possibility of one or more pockets of accumulated cold water in this header from unsuspected source. It is on this possibility that I base my conclusion.

As the supply valve is slowly opened, the water vapor that is present when hot water is being pumped leads the water through the header, usually following the top of the horizontal part of the header for a considerable distance ahead of the water. As this steam condenses, an area of low pressure is formed and the cold water accumulation in the bottom of the header hastens to this low pressure area rapidly, striking fittings and bends that tend to deflect the movement from its course and will continue to do so until the pipe and water is heated to about the same temperature.

The cause of the trouble may be that the header was subjected to an unequal expansion, and was distorted; this may have occurred when the supply valve was slowly opened and the steam present with the water heated the top of the pipe before the bottom, causing the header to buckle and leaving pockets for the accumulation of water.

A check-up on the expansion movement and pitch of this troublesome header will reveal pockets, which should be removed or drained.

To prevent an occurrence of this unusual condition in the other header, provision should be made to stop the line from lifting when the valve is opened slowly and the line permitted to heat up gradually. WILLIAM ANDERSON.

Brooklyn, N. Y.

WATER-HAMMER when one section of header is in use and the absence of water hammer when the other section is used is very likely due to the difference in construction of the two headers.

Not knowing any of the details of construction, I assume that a portion of the header which does not give trouble is acting as an air chamber, or shock absorber. Recently I had a similar case with a battery of four boilers numbered 1, 2, 3 and 4, starting with No. 1 at the east. A feed-water header runs the width of the settings and a branch from this to each boiler, the feed supply from the pump enters the headers at the west end. When boilers No. 3 and 4 were in service no water-hammer occurred, and when boilers No. 1 and 2 were in use the water-hammer was pronounced and dangerous.

I decided that when boilers No. 3 and 4 were in use, that portion of the header between boilers No. 1 and 3 was acting as an air chamber. To prove this theory we installed an air chamber at the extreme east end of main header, and the result was the complete elimination of water-hammer.

WESLEY J. HANSEN,
Muirdale Sanatorium.

Wauwatosa, Wis.

Engineering Aspects of Interchange of Power

By B. F. WOOD
Vice-President Allied Engineers, Inc.

In this abstract of a paper presented at the recent World Power Conference in Berlin, Mr. Wood stresses the mutual advantages obtainable by contracts based on sound engineering principles and recognizing the interests of both parties

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TO SECURE maximum reliability and economy of power service, and the fullest utilization of any waste heat or usable surplus power, some arrangement must be made to bring about a massing of the industrial and utility companies' resources of power production. This is hardly possible if the utility company limits its activity solely to the furnishing of electric service, particularly if the utility company adheres rigidly to an established schedule of rates.

A discussion between utility and industrial people frequently starts with a mutual distrust of each other's cost statements, which leads to dickering and may end in the industrial company's determining to be wholly independent in its entire power service. Recently a broader and more liberal view has prevailed and progress is being made in bringing about agreements to the mutual advantage of both interests. To some extent, this change of attitude may be due to a better understanding of unity of interests.

Among the means that may be employed to secure the advantages of massed resources of power production, with respect to utility and industrial plants, may be mentioned:

1. Interconnection of the electric circuits, securing advantages of protection of service, diversity of load conditions, economy of operation, etc.

2. Establishment of jointly owned plants and facilities, supplying to the industrial plant electric, steam, or other power service, utilizing the utility system as the reservoir from which to draw or into which any and all surplus electric power may be poured.

3. Building and operation of plants and facilities by a utility company near the industrial plant, supplying such power service as required by the industrial plant, making up any deficiency from, or taking any surplus electric power on, the utility company's power system.

In the first case we have the possibilities by interconnection between different utility systems with the further advantage, usually, of a different character and greater degree of diversity of load.

But it is the last two cases that present the greatest possibility for a mutually advantageous arrangement between industrial and utility plants and that make the engineering studies to secure maximum economic results most interesting.

In the establishment of jointly owned plants or the allocation of a portion of the plant facilities to the service of the industrial plant, the total investment may be minimized. Many plant facilities, such as real estate, railroad sidings, coal- and ash-handling equipment, etc., need not be duplicated. Spare equipment may serve as spare for both the industrial and utility. The organization for operation and maintenance may be spread over both operations.

A good illustration of the second case is the Deepwater station, located on the New Jersey side of the Delaware River, just opposite Wilmington, Del. This station is jointly owned by the American Gas & Electric Company and United Gas Improvement Company, with a portion of the plant allocated to the services of the E. I. duPont de Nemours & Company. [See *Power*, May 27, p. 813.—Editor.]

As an example of the third class, that is, where the utility company owns and operates the plant and facilities, we may cite the case of a steel company wishing to change its rolling mills and other steam-engine-driven equipment to electric motor drive. The steel company produces finished products in an amount of approximately 90,000 gross tons per month.

It was found that after making use of coke-oven and blast-furnace gas in heating furnaces and other metallurgical operations sufficient gases were available to supply the steel company's electric power requirements after complete mill electrification. The steel company's electric power requirement will then be about 300,000,000 kw. annually, with a maximum demand of 54,000 kw.

The available waste gases will produce more than the steel company's requirements, with a surplus of some 40,000,000 kw.-hr. annually. The steel company would either have to install complete spare equipment or relay its electric power service from the utility company's power system, thus either materially increasing its annual capital charges or adding to its operating charges for reserve or stand-by service.

Such an industrial is usually not prepared to make large capital investments, except under pressure of necessity, unless the annual return on the capital investment is greatly in excess of that required in the diversified power service of a utility company.

This situation led to the suggestion that the utility company build, own, and operate the power plant and facilities, purchasing the waste heat from the steel company at substantially the equivalent cost of other fuel, and furnish the steel company with its entire electric power requirements on a cost basis to yield a proper return on the investment.

The utility company could build a station designed to operate at 1,400 lb.

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"TO SECURE *the maximum degree of reliability and economy of power service, and the fullest utilization of any waste heat or usable surplus power, some arrangement must be made to bring about a massing of industrial and utility companies' resources of power production.*"

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pressure, instead of 400 lb. as contemplated by the steel company, providing no spare generating equipment. The utility company could relay the steel company's service with the spare equipment required for its other service. Such a plant, in addition to supplying the steel company's requirements, could generate some 100,000,000 kw.-hr. annually at a cost that could advantageously be poured into the utility company's system.

The net result will be to furnish the steel company's entire electric power requirement at a cost comparable with any cost to itself and to save the steel company an investment of something over $6,000,000 in power station facilities and to increase the annual return on the money to be spent by the steel company on its electrification program from about 20 per cent to about 25 per cent.

While as yet no actual contract has been consummated to carry out this program, the general principles have been accepted pending the development of details. The resources will be massed, no usable product wasted, and capital investment conserved.

A case now under consideration is that of a large manufacturer using some

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"IN PRINCIPLE *the industrial should pay the power company a reasonable rate of return on all investments made on its account and also pay its proper share of all operating costs. In practice it is often desired to reduce the payments to unit rates for steam and electric power.*"

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3,000,000,000 lb. of steam per year for process and heating and at the same time buying and generating electric power up to a maximum demand of 42,000,000 kw. The manufacturer is faced with the necessity of abandoning one of two large boiler plants, and can therefore effect substantial gains by building a high-pressure boiler plant and generating byproduct power. Here again even better over-all results can be obtained by the public utility company's building the new plant and serving both the steam and electric power requirements, primarily because the utility company can make a materially greater use of the investment in plant facilities.

The economic advantage of expanding high-pressure steam through engines or turbines to make byproduct power before the steam is used in process work is being lessened by two factors, namely: The constantly improving thermal performance of modern large turbine installations, and the higher cost of boilers, evaporators, and other equipment required for byproduct production with high steam pressures.

Only a few years ago, a station thermal performance of 20,000 B.t.u. per kilowatt-hour was regarded as excellent. Many large central station plants are now being designed for approximately 12,000 B.t.u. Byproduct

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"THERE ARE *undoubtedly thousands of opportunities for the establishment of means and facilities to utilize massed resources to serve the power requirements of industrial plants. The advent of high steam pressures has largely increased these possibilities.*"

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power may be obtained for about 5,000 B.t.u. per kilowatt-hour, but in high-pressure plants evaporators are usually necessary to insure scale-free water in the boilers, and as much as 6,000 B.t.u. per kilowatt-hour may be required.

The ratio has thus been changed from about 4 to 1 to 2 to 1. If, to obtain byproduct power, it becomes necessary to make large capital investment or if the rate of annual fixed charges is high, the economy of an independent high-pressure plant to supply the service to an industrial company is thus greatly reduced. The economic results of a station supplying combined service to an industrial plant and a utility system may, however, be definitely improved, and in any event should be better than is possible if each develops independently.

The principles of contractual relations between the industrial and power company are simple, but their application may be complex.

In principle, the industrial should pay the power company a reasonable rate of return on all investments made on its account and also pay its proper share of all operating costs. In practice, it is often desired to reduce the payments to unit rates for steam and electric power.

While it is relatively simple to ascertain the probable costs for any given set of operating conditions, it is difficult to determine unit rates which will be equitable at all probable ranges and conditions of electric load and steam flow.

For instance, if byproduct power from steam be involved, then the combined unit cost of saving both steam and electric power is a minimum when the investment in steam capacity is fully utilized and when the electric power requirement is just that of the byproduct power available from this amount of steam.

Any unbalanced conditions from this exact relation between the quantity of steam and of electric power will increase the combined unit cost. Hence, the unit rates for each should bear some relation to the quantity of the other, and in the limit be equitable, on the one hand, for furnishing steam only a portion of the time and, on the other hand, for furnishing electric power only a portion of the time. This requires a very careful survey of all probable operating conditions, and a clear understanding between the engineers of both companies.

Many other examples of the interchange of power with industrial plants might be cited. There are undoubtedly thousands of opportunities for the establishment of means and facilities to utilize massed resources to serve the power requirements of industrial plants. The advent of high steam pressures has largely increased these possibilities and extended the engineering problems involved in their proper solution. The engineer must seek the maximum over-all economy with minimum investment, having regard for reliability of service; then work out a plan for the undertaking that will be to the mutual advantage of all parties at interest. These problems are of special interest because of the many new and unusual factors involved.

Unprecedented Drought Costs Nation Millions

DEPLETION of hydro-power during the current drought is costing industry millions of dollars in auxiliary fuel consumption, according to estimates prepared from United States Geological Survey data. During May of this year, the deficiency of hydro output was roughly a quarter of a million kilowatt-hours. Fuel costs to supply this shortage totaled nearly $1,000,000. Although statistics for June and July are not yet available, it is obvious that the condition was worse than in May. Relief is not yet in sight.

It must be remembered that a long-time deficiency in rainfall is responsible for the trouble, rather than the record-breaking spells of hot weather. Stream flow depends on ground storage during the summer months, now becoming prematurely depleted. Evaporation is a fairly constant and minor factor compared with rainfall. The present condition is serious in that areas east of the Rocky Mountains are reaching low water conditions unusually early in the year and some streams are already approaching record low water. Minimum flow for an average year in the East does not come till sometime between September and November. Thus, even if rainfall during the balance of the summer picks up to average, which seems unlikely, some streams may be expected to continue falling and to reach a minimum for all time before the end of the year. Western streams depending on snow water are not so badly off. The trend toward sub-normal hydro production started back in May, 1929.

Long Distance D.-C. Transmission of Power Believed Possible With Thyratron Tube

Experiments at G. E. research laboratory demonstrate feasibility of using direct-current transmission with consequent increase in efficiency and economy

RECENT EXPERIMENTS in the research laboratory of the General Electric Company tend to substantiate the belief that the Thyratron tube, now used to control power supply, may become the means at some future time of accomplishing power transmission under more advantageous electrical conditions than those at present prevailing. This idea is based on the expectation that the tube may make it possible to transmit electrical energy over relatively long distances by means of direct current instead of alternating current.

Seeking to develop this proposition, an experimental miniature transmission line was set up in the laboratory and equipped with Thyratron tubes. The artificial transmission line itself was represented by a copper bar about seven or eight feet in length. Electrical conditions were imposed, in the matter of ohmic resistance, which made this line equivalent to 400 miles of transmission conductor in a commercial system. As the longest commercial system now in existence is 250 miles in length, this experimental line, in its electrical characteristics, was more than 50 per cent beyond present practice.

At the sending end of the line was installed a bank of Thyratron tubes functioning as rectifiers, to convert alternating current into direct current for transmission purposes. At the receiving end of the line were installed other Thyratron tubes which functioned, in pairs, as inverters to change the direct current back into alternating current. The source of supply for the experimental system was a bank of transformers, which furnished alternating current at 15,000 volts.

When this interesting experiment was tried, it was found that transmission of the power was accomplished without difficulty, and that the Thyratrons, operating at one end as rectifiers and at the other end as inverters, handled successfully the current at 15,000 volts. At the receiving end the tubes delivered the energy to transformers, which reduced the pressure to the voltage of the working circuits in the laboratory shop, and through these circuits it was put to work in motors.

As a further demonstration, the experiment was later repeated with the addition of a double-conversion process at the receiving end of the experimental line. After having been inverted and sent through step-down transformers, the current was passed through a motor-generator set and reconverted into direct current at working voltages. Thence it was supplied to shop circuits which required direct current, for regular work in direct-current motors.

The experiment was regarded as significant of what may be in store at some future period in electrical engineering developments. It is quite possible, from the present trend as revealed by this experiment, that within the next decade—precisely how soon laboratory men do not care to speculate—direct-current transmission on a scale comparable with, or at least approaching, the present practice with alternating current will go into commercial usage.

Not since the earliest days of commercial application of electricity has direct-current transmission been considered practicable. Fifty years ago, when arc lights first came into use, followed a few years later by Edison's incandescent lamp, almost all transmission in commercial systems was by low-voltage direct current. But the disadvantages of such systems under present-day conditions would make them highly impracticable. If, however, transmission by direct current at high voltages can be accomplished, with the aid of the Thyratron tube, the benefits, both electrically and economically, will be decidedly noteworthy.

The Thyratron tube has been fifteen years in reaching its present state of development as a perfected and effective control device. After Dr. Irving Langmuir had conceived the idea of making use of the characteristics displayed by electron discharges in gases for controlling an electric arc by means of a grid, Toulon, in France, experimented in 1922 with Langmuir's process and devised an improvement on his method. Later Langmuir and his assistants made other improvements. About 1926 Langmuir envisioned the broad practical possibilities of the principle, and thereafter Dr. A. W. Hull, in the same laboratory, developed the tube to its present status, making its commercial use in controlling power supply a reality. The tube, of the three-electrode type, differs from the familiar Pliotron tube in being an arc rectifier in which a power arc is controlled electrostatically by the grid. In its control function it will economically handle relatively large amounts of power.

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Melting Point of Many Substances Changed by Application of High Pressure

PRESSURES so great that they enable ice to withstand a temperature of 180 deg. and change ordinary substances into new forms of matter are described in a report to the Engineering Foundation by Dr. P. W. Bridgman, Hollis, professor of mathematics and natural philosophy in Harvard University.

Professor Bridgman's experiments, conducted over a period of several years, have involved the use of compressions equal to 580,000 lb. per square inch. Under such pressure, gases become as dense as liquids, and the expansion which heat normally causes in liquids increases, instead of decreases, at low temperatures.

Even the molecules which compose gases, invisible under the most powerful microscope, and the atoms which, in turn, form the molecules, are driven together, Professor Bridgman says, by the force he has employed in the experiments.

Important changes in volume were produced, it was found, in substances ranging from water to metals. Under a pressure of 88 tons per square inch, the volume of many of the metals was decreased several times more than it could be reduced by cooling to absolute zero.

"Electrical resistance of thirty-nine pure metals decreased by hydrostatic pressure by amounts varying with the character of the metal," the report says. "This decrease under pressure of 176,000 lb. per square inch ranged from 1 per cent for cobalt to 73 per cent for potassium. Six or seven metals increased in resistance under pressure."

Pressure effects on viscosity have been measured for forty-three liquids. For all, except water under a limited range of pressure and temperature, viscosity increases under pressure, but by amounts that vary enormously from substance to substance.

The most striking effect produced by high pressure is in the change of melting point of many substances, or in the different crystalline forms which are stable under high pressures although not stable under low pressures.

For instance, the melting point of liquid mercury can be brought up to the temperature of the room by application of 176,000 lb.; ordinary ice becomes unstable at pressures greater than 29,000 lb. per square inch and is replaced by other forms, one of which is stable under a pressure of 290,000 lb. at temperatures as high as 180 deg. F., so that we can have the paradoxical substance, "hot ice."

Also there is a new form of phosphorus produced by high pressure which is in appearance like ordinary graphite, and is a conductor of electricity.

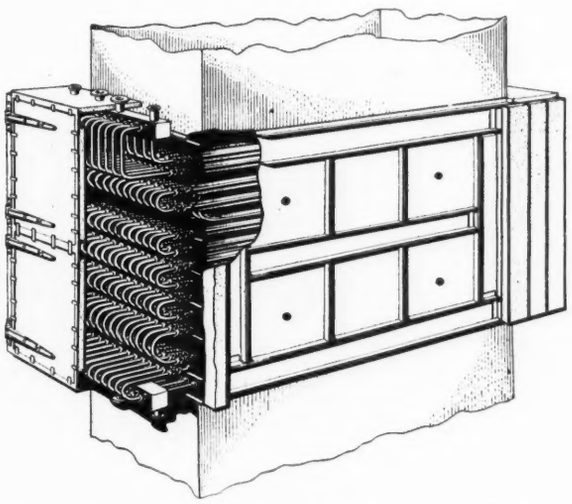
WHAT'S NEW IN PLANT EQUIPMENT

HOW THE MANUFACTURER CONTRIBUTES TO THE JOB OF GENERATING, TRANSMITTING AND APPLYING THE POWER SERVICES

Extended-Surface Economizer

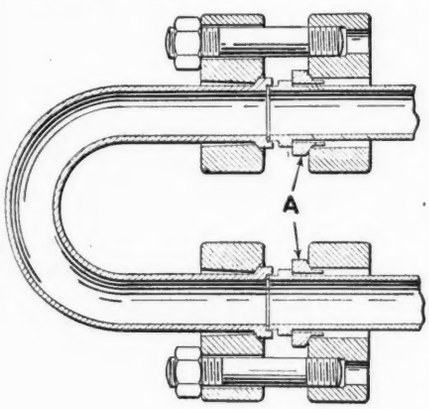
USE of external and internal return bends, two separate water circuits, and fin tubes are some of the features of the new extended-surface economizer now being put out by Combustion Engineering Corporation, 200 Madison Ave., New York City.

The heat absorbing elements are constructed by connecting straight-finned tubes in series by U-bends as shown. The adjacent vertical tube sections are arranged so that the open ends of the U-tubes alternately enter one end and then the other of the economizer casing. The water circulation is separated into two circuits, one running through the U-tubes connected by the return bends at one end of the unit and the other through the U-tubes connected by return bends at the other end of the unit. Both circuits are served by common inlet and outlet headers.



Economizer with part of end cover removed, showing bends connecting U-tube sections

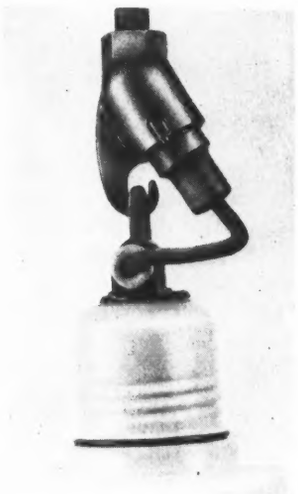
Method of connecting bends to tubes



Compactness is effected through the use of fin tubes, which reduces the tube length per square foot of heating surface, and the return-bend arrangement, which permits the tubes to be nested closely together so that the space they occupy is said to be less than half that required for a straight-tube unit of equal heat-absorbing surface. The end plates are designed to permit of their being quickly and easily removed for inspecting and cleaning of tubes.

Safechange Lamp Hanger

A DEVICE which permits of the easy and safe removal of industrial units for cleaning or relamping is announced by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. The upper casting, which includes the hook, is threaded at the top for attachment to the conduit, and in it is the receptacle for the plug used for connecting and disconnecting the lighting unit. The lower part, which is fastened to the lamp socket, consists of an eye, through which the hook on the upper casting fits, and a housing for a porcelain bushing through which the cable to the plug passes.



Unit must be disconnected before it can be removed from hook

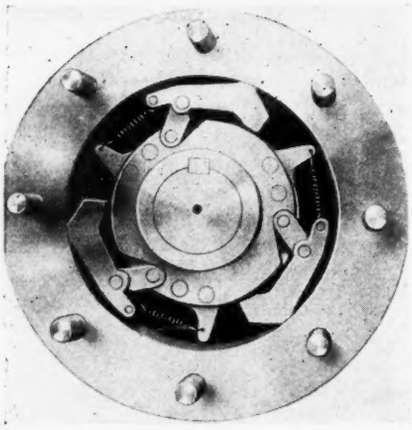
This arrangement prevents the hook from being engaged or disengaged while the plug is in place. Therefore, a unit cannot be removed or replaced without first disconnecting it from the line.

One-Way Non-Slip Clutch

DESIGNED to take the place of any form of rachet or backstop, the Pitter clutch illustrated, developed in England, is now being introduced in this country by the Universal Gear Corporation, 327 South La-Salle St., Chicago, Ill.

The clutch, which is claimed to be instantaneous on clutching and release and to operate without lost motion, consists of a central spindle carrying three pivoted arms at the outer end of which are shoes fitting in an annular groove. Light coil springs serve to keep the shoes always in position for gripping.

In operation, when the spindle is rotated in the driving direction, the



Pitter clutch for one-way drive

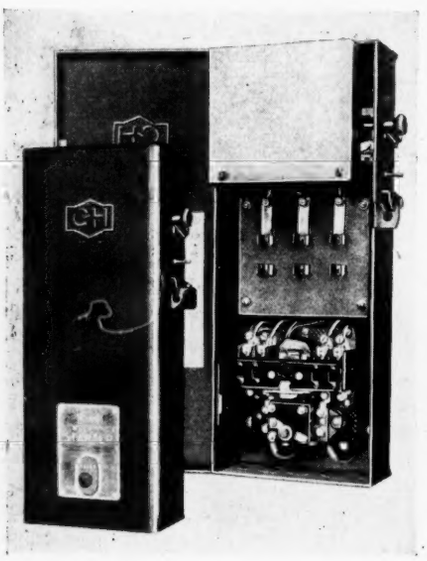
shoes lock against the inner and outer sides of the groove, thus giving a positive lock at two points on each of the three shoes. This action, it is claimed, takes place instantly, with no lost motion. The rapidity of action is said to be practically unlimited, and clutches are now in use in which the shoes lock and unlock more than thirty times a second.

The shoes and annular grooves are made of high-grade steel hardened and ground. All the load is taken by the outer end of the shoes, no load being taken by pins or links shown, these serving to hold the shoes in gripping position. All parts are lubricated, as the clutches are made oil tight and filled with oil. Sizes are available for shaft diameters from $\frac{1}{4}$ to 6 inches.

Motor Starter With Fusible Disconnect Switch

IN THE combined across-the-line starter and fusible disconnect switch recently announced by Cutler-Hammer, Inc., 190 12th St., Milwaukee, Wis., a wiring channel is provided between the starter panel and the back of the steel inclosing case which allows running the connecting wires behind the panel, where they cannot interfere with the operation of the starter.

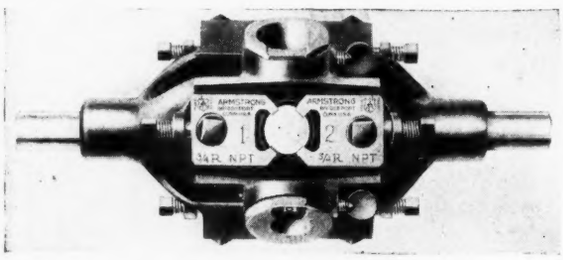
All parts are mounted on a back plate which is easily removed for pulling and placing of line and motor wiring. The disconnect switch is manually operated from the outside. A cover interlock prevents opening of the cover when the switch is closed and prevents closure of the switch if the cover is open, unless the interlock is manually released. An electrical interlock insures that the magnetic contactor of the starter is always open when the disconnect switch is open.



Open and closed views of starter

Adjustable Three-Way Diestock

IN THE adjustable three-way diestock illustrated, put out by the Armstrong Manufacturing Company, Bridgeport, Conn., one stock is so constructed as to contain three sets of dies, each of which is adjustable for cutting over- and undersized threads. Several combinations of dies are possible with the one stock—three dies for three sizes of pipe—a die for brass or copper, or bolt and rod can be combined with two others. The method of placing the dies and bushings on one stock will be clear from the illustration. Two sizes are available, 60A, for pipe of $\frac{3}{8}$, $\frac{1}{2}$ and $\frac{3}{4}$ in., and 60B, for pipe of $\frac{1}{2}$, $\frac{3}{4}$ and 1 inch diameter.



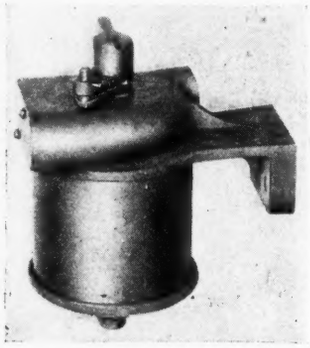
Stock fitted with three sets of dies

New Line of Mill and Hoist Motor Brushes

THE Speer Carbon Company, Saint Marys, Pa., has recently brought out a new line of brushes for use on milltype and hoist motors. The line includes grades suitable for all types of mill and hoist motors, operating under varying conditions and at all voltages of alternating or direct current.

Unit-Type Auxiliary Switch

A NEW unit-type auxiliary switch for use with oil or air-break switches, motor-operating mechanisms, and similar equipment has been developed by the Delta-Star Electric Company, Chicago, Ill. It can be made to open or close the current at any desired position. If it is desirable to have one unit circuit-opening instead of a current-closing, or vice-versa, a simple adjustment permits of this without taking the switch apart. A single unit switch is illustrated.

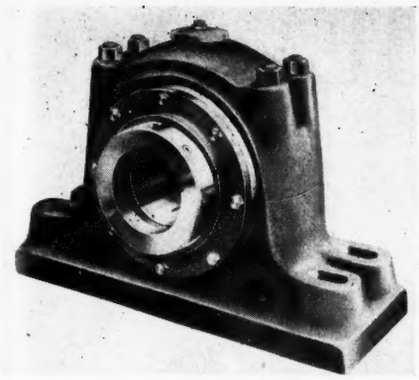


Auxiliary switch for oil- or air-break switches

Roller-Bearing Ball-and-Socket Pillow Block

A SELF-ALIGNING roller-bearing pillow block has been announced by the Link-Belt Company, 910 South Michigan Ave., Chicago, Ill. It is available in commercial shaft sizes from $1\frac{7}{16}$ in. up. Some of the features of the bearing are: Ball-and-socket design for complete alignment; positive-pressure lubrication; adequate closures; double-bearing construction; and the use of adapter sleeves.

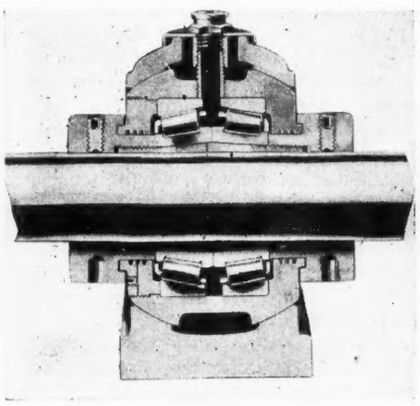
As the cross-sectional view shows, the bearing elements consist of two tapered-roller bearings with inner races abutting and secured on the shaft by tapered adapter sleeves. These sleeves are tightened on the shaft by solid, threaded adjusting collars, locked by set-screws. Adjustment of the outer races of the bearings themselves is by a threaded



Pillow block assembly

cap on the smaller-sized pillow blocks, and by a cap with shims and capscrews on the larger sizes. Seal against the entrance of dirt is by three grease grooves and a labyrinth formed between the adjusting collars and the housing ends.

These bearings are designed for grease lubrication through an indus-



Cross-section of pillow block showing how self-alignment is obtained through a ball and socket

trial fitting, piped to a point between the two roller bearings. An aluminum dust shield surrounds the fitting and prevents entrance of dirt into the spherical ball-and-socket surfaces through the opening in the pillow block made necessary because of movement of the grease pipe during initial alignment.

Lapping Compounds

AMONG claims made for the lapping compounds being put out under the name of "Timesaver" by the Abrasive Engineering Laboratories, Inc., 117 No. Jefferson St., Chicago, Ill., are that the materials break down from an abrasive to a fine polish and will not embed in any metal surface and that compounds may be used for fitting either new or reconditioned bearings and produce smooth open-pored surfaces which retain the oil film. Shaft bearings lapped with a "Timesaver" compound require no further running in. The compounds are easy to use and rapid in finishing, cutting at first and gradually reducing to a smooth polishing agent, leaving the surfaces in a smooth condition.

These features make the material suitable for finishing of valve seats and disks, cylinder walls, bearings and like work. No. 60 compound is used for babbitt and similar soft-bearing metals, No. 80 for bronze, and No. 111 for cast iron. The compounds are mixed with ordinary medium-grade machine oil to a thick consistency for medium-size bearings and thin for large bearings. The compounds are available in 1½-oz. and 3-oz., and 1-, 5-, 10-, 25-, and 50-lb. containers.

New Switchboard Requires Small Space

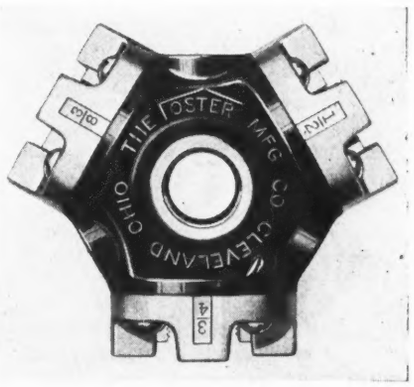
AN INCLOSED miniature switchboard to control an electrical system from a central point is announced by the General Electric Company, Schenectady, N. Y. It is made up of one or more self-contained units arranged in circular formation. Each individual unit is furnished complete by the manufacturer and is made of welded fabricated parts. It occupies an angular space of 30 deg., so that a total of six units can be mounted in the half-circle, leaving the operator a space of 4½ ft. in diameter.

Instrument indication is provided in addition to the usual lamp indication of breaker position, and where desired synchroscope jacks can also be mounted on control key panels.

The equipment is inclosed, and the wiring may be inspected through a double door on the back of each unit. These doors can also be used for mounting protective relays and watt-hour meters, which are wired with flexible cable to the terminal blocks on the inside of the unit. The flush-mounted instruments, in the upper section, are uniformly 4½ x 4 in., for both alternating-current and direct-current instruments. They are furnished with anti-parallax scales and pointers, the elements being a modification of those used in standard-sized instruments. Supports on each unit provide mounting for a total of 36 instruments in addition to a synchroscope and two voltmeters.

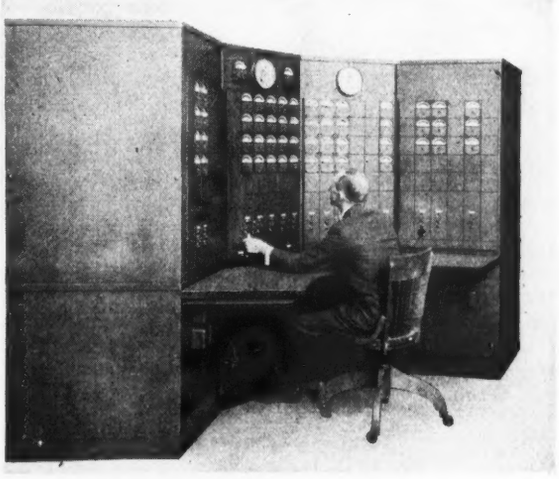
Three-Way Threading Tool

SMALL, light weight, and the ability to put a standard length thread on a pipe as close as 4⅝ in. to the wall are features of the new three-way threader for ⅜, ½ and ¾ in. pipe put out by the Oster Manu-



Three die pipe threader

facturing Company and the Williams Tool Corporation, Cleveland, Ohio. The new threader, designated No. 000 "Chip Chaser," uses the same open-type die holders as the regular "Chip Chaser" made by the company. Dies are arranged on the stock 120 deg. apart, with the proper size guide diametrically opposite each die.



Assembly of four units equipped with small instruments

NEWS of the FIELD

Spot News

HYDROGEN COOLING, *by which it becomes possible to reduce electric losses to about 75 per cent of the value obtained with air-cooled equipment, is to be used with a 50,000-kva. synchronous condenser which is being constructed at the Schenectady works of the General Electric Company for outdoor installation at the La Fresa substation of the Southern California Edison Company. The new unit is by far the largest in size and capacity of any hydrogen-cooled unit built so far.*

APPLICATION *for a preliminary permit covering a 300,000-hp. hydroelectric project on the Sultan, East Wallace and Olney Rivers, North Fork of the Skykomish River, West Cady and Troublesome Creeks in the State of Washington, was filed with the Federal Power Commission last week by the Great Northern Power Company. With three power houses, it is proposed to install 600,000 hp., or twice the primary capacity of the site.*

WHAT IS BELIEVED *to be a record for long-distance transmission of electric power at 66,000 volts was established recently by the Central Power & Light Company when it placed in operation a line connecting its generating plant on Devil's River, Del Rio, Texas, with the Gulf Coast district at Robstown, a distance of 362 miles.*

CONTRACT *for five more huge hydraulic turbines to be installed in the world's largest water-power plant on the Dneiper River in Soviet Russia has just been awarded to the Newport News Shipbuilding & Drydock Company. The Virginia firm already has under construction four turbines of the same type for the same plant. Developing 1,000,000 hp. under a head of 123 ft., they will be the largest hydro units ever built. Shipment of the turbines will begin in December.*

Sinclair Building New Steam Plant at Wellesville, N. Y., Refinery

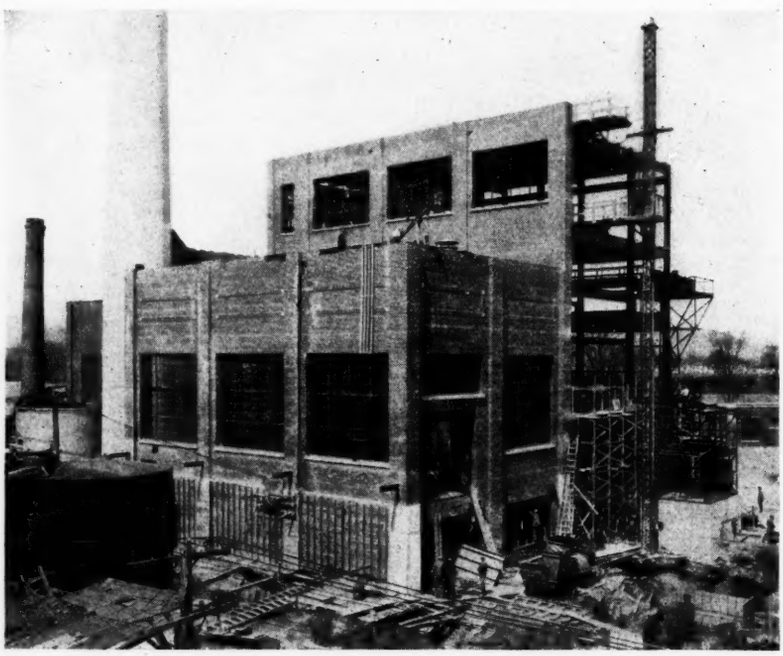
CONSTRUCTION of a new 1,500-kw. steam plant is progressing rapidly at the Wellesville, N. Y., refinery of the Sinclair Refining Company. Of modern design throughout, the new plant will supply all power needed for operating the oil refinery. The installation comprises two boilers, two turbine-generators, four air compressors and the usual auxiliary equipment. Provision has been made for the addition of a third unit when power requirements of the plant demand it.

Oil-fired, both boilers are Babcock & Wilcox 7,500-sq.ft. water-tube types. Steam from the boilers has a pressure of 400 lb. and a temperature of 550 deg.F. and feeds two Moore 750-kw. non-condensing turbines exhausting at 125 lb. pressure and 350 deg.F. temperature. The exhaust steam is used for process work at the refinery.

Supplying compressed air are four synchronous-motor-driven air compressors. Two have a capacity of 750 cu.ft. per minute at a pressure of 100 lb. The remaining two supply 1,100 cu.ft. per minute at a pressure of 50 pounds.

The electrical equipment comprises two Westinghouse 750-kw., 80 per cent power factor, 2,300-volt, 60-cycle generators with embedded thermo couples for measuring internal temperatures and with direct-connected exciters; two 150-hp., 327-r.p.m., 2,200-volt, 3-phase, 60-cycle, 80 per cent power factor, synchronous motors for driving air compressors, with two motor-generator sets to provide field excitation for the above-mentioned motors; two 175-hp., 328-r.p.m., 220-volt, 3-phase, 60-cycle, 80 per cent power factor, synchronous motors for driving air compressors, with two motor-generator exciters for these motors; two magnetic, full-voltage starters for the 175-hp. motors, and complete switching equipment.

The switchboard is designed to provide control for the two generators and for a third generator which will be added when demanded by the power requirements of the plant. It is of the all-steel type, self-contained and self-supporting. The alternating-current generator and feeder panels are hinged to provide easy access to the rear of the board and to the small wiring. All disconnecting switches are protected by barriers at the top of the structure.



Construction photograph of the new steam power plant of the Sinclair Refining Company, Wellesville, N. Y.

Gas Explosion Kills Twelve in Hetch Hetchy Tunnel

A terrific explosion of natural gas killed the twelve men composing the entire crew in the east heading of the Mitchell shaft in the Coast Range tunnel of the San Francisco Hetch Hetchy project on July 17. The crew of 21 at work in the west heading at the time of the explosion made their way to safety up the 800-ft. shaft. Following a preliminary examination, which revealed the fact that all the members of the crew had been killed, reconstruction work in the damaged shaft and ventilating system was undertaken under protection of rescue crews, equipped with gas masks, directed by experts of the United States Bureau of Mines. Investigations were started immediately by the city of San Francisco, the State Industrial Accident Commission, and Federal agencies.

The blast is estimated to have occurred about 900 ft. east of the shaft, which is one of the five intermediate openings on the line of the 28-mile tunnel through the Coast Range, the last mountain barrier on the aqueduct line, to bring a new water supply to San Francisco. The material encountered is a sedimentary formation and the occasional presence of gas is guarded against by safety equipment and regulations.

The exact cause of the explosion probably never will be determined, since the entire crew was killed. Possible causes which have been advanced include a broken light globe, sparks from a motor, or an infraction of the smoking rule at the time when a gas pocket was encountered.

Hoover Consults Mitchell on Power Appointments

President Hoover has asked the Attorney General Mitchell if the amendment to the Water Power Act, reorganizing the Federal Power Commission, will permit of recess appointments. The President, on July 19, sent to the Senate for confirmation the names of Marcel Garsaud, of New Orleans, for the three-year term; Ralph D. Williamson, of Washington, for the two-year term, and Claude L. Draper, of Wyoming, for the one-year term. These nominations were reported favorably by the Interstate Commerce Committee, but objection to immediate consideration was voiced by Senator Walsh, of Montana, and Senator McKellar of Tennessee.

Senator Walsh announced that because of the importance of the appointments and because little information had been made available concerning the nominees, he thought it inadvisable that they should be considered upon such short notice and objected to their immediate consideration.

The act provides that the new commission shall be composed of five members to be "appointed by the President, by and with the advice and consent of the Senate." The three commissioners could "take office" under a recess appointment by the President, but the specific reference to section one, where confirmation by the Senate is required, may be found to preclude the usual practice of allowing the President to fill offices during recess of Congress.

Iowa Cities May Not Pledge Income to Buy Plants

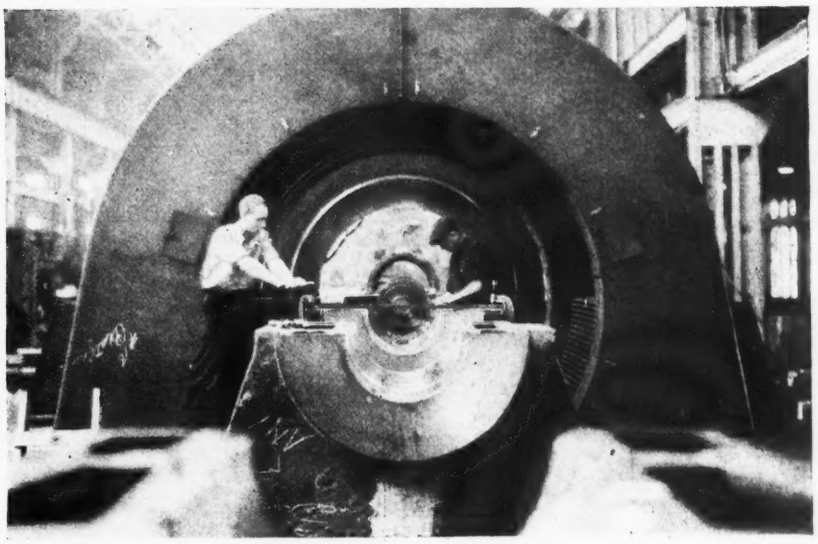
Iowa cities have no power to pledge property, either personal or real, and a contract is void that undertakes to pledge the rents, income, and profit of an electric light plant to be constructed in the future, it was held July 23 by the Iowa Supreme Court.

The decision affirmed a judgment of a lower court, declaring void a contract between the town of Sidney and Fairbanks, Morse & Company for the purchase of engines and machinery for an electric plant, to be paid for by the issuing of pledge-orders payable out of the net revenue of the proposed plant.

"Regardless of what the law may be in other states," the supreme court said, "it is settled in this state that a municipality has no inherent power to make a contract of this kind. A municipality is wholly a creature of the legislature, and possesses only such powers as are conferred upon it by the legislature."

The court further stated that powers conferred upon a municipality can not be enlarged by liberal construction, and where a statute confers certain powers, those not enumerated are withheld.

WHERE ACCURACY COUNTS



Lining up the stator on the base of a General Electric 27,500-hp. induction motor. This motor, part of a 20,000-kw., 300-r.p.m., Scherbius control, 25- to 60-cycle frequency converter, will be shipped to the Union Electric Light & Power Company, St. Louis, Mo. The pedestal bearing shown in this view measures 18 in. in diameter by 31½ in. at the bearing surface

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News of Canada

Canada and U. S. firms may develop Horseshoe Bend—Rapid progress made on Jordan River — Calgary completes Ghost-Edmonton line

IN CONNECTION with the desire of the Province of Saskatchewan to develop some of its more important water-power sites, the government is now reported to be considering a proposal by interests of Eastern Canada and the United States for the expenditure of $4,500,000 on construction of a hydro-electric plant at what is known as Horseshoe Bend on the Saskatchewan River. The site is about 35 miles east of Prince Albert. It is understood that the Fraser Brace Engineering Company, of Montreal, and Rolling & Sons, of Boston, are backing the scheme. It is considered that the development of northern Saskatchewan's pulp wood resources would follow completion of the project.

RAPID PROGRESS is being made in laying and riveting the large stock in connection with the 18,000 hp. addition being erected by the British Columbia Power Corporation to its hydro-electric plant on the Jordan River, Victoria Island. Equipment for this installation, amounting to about 100 tons, was recently received at Vancouver and transshipped to Jordan River. This work forms part of the extensive program

planned by the corporation on the mainland and island to meet the growing power needs of the territory served. It is estimated that when present plans are completed the company will have spent about $55,000,000. The program is being undertaken in stages and will cover several years work.

CALGARY Power Company's high tension transmission line from its Ghost plant in Alberta to the city of Edmonton, has been completed and power is being delivered to the city under the terms of the contract agreed upon by the city and the utility company. Operation of this new system marks a significant step in the progress of the company. Construction of the line completes a program of expansion of which the development of the Ghost site was the first step. Approximately 36,000 hp. is being developed.

The agreement with Edmonton covers a five-year period. It provides for the purchase of power by the city at the yearly rate of 0.5c. per kilowatt-hour for the first 20,000,000 kw.-hr. and 0.4c. for all power in excess of that amount.

Engineers Selected to Make Los Angeles Power Survey

Approval has been given by the Los Angeles Board of Water and Power Commissioners of the three engineers selected by the Chamber of Commerce to make a survey and report on the city's proposed power development program from an engineering standpoint. The bureau of power and light wishes to place on the ballot at the primary election, Aug. 26, a measure authorizing a bond issue of $19,000,000 as a part of a tentative three-year financial program totaling $31,000,000, of which $12,000,000 is to be derived from power revenue.

The engineers chosen are W. F. Durand, emeritus professor of mechanical engineering, Stanford University; R. W. Sorensen, professor of electrical engineering, California Institute of Technology; and A. V. Guillou, assistant chief engineer of the California Railroad Commission.

Sue A. O. Smith Corporation on Arc Welding Patent

The arc-welding process used by the A. O. Smith Corporation of Milwaukee, Wis., is involved in a patent infringement suit started recently in the federal court at Milwaukee by the Automatic Arc Welding Company of Detroit, Mich. The Detroit company charges that the Smith corporation, a national leader in the production of welded transmission pipe, has used methods patented by Harry D. Morton, secretary and treasurer of the Automatic Arc Welding Company. The suit asks that the patent of Mr. Morton be recognized as valid and that a temporary injunction restraining the Milwaukee firm from using the process be issued pending settlement of the litigation.

An appeal is made to the federal court that the Smith company be ordered to destroy all alleged infringing equipment and be required to give an accounting of all profits resulting from the use of the welding system, which during the last three years is said to have run into millions.

The complaint filed in court declares that Mr. Morton obtained his patent on welding in 1918 on his development of portable welding machines and that other important patents were obtained by him in 1927, held jointly by him and the Automatic Arc Welding Company.

How's Business?

BUSINESS is running true to form in mid-summer of a depression year. Industrial activity is at a low level, accentuated by shutdowns, vacations, and a general marking time till the turn of the tide becomes evident. Building continues well sustained, somewhat beyond the point of seasonal decline, and the fair volume of contracts placed in the first half will exert their force upon general business from now on. General trade has slackened considerably as the cumulative influence of six months of lowered purchasing power, and depleted stocks begin to be felt. Our index of general business activity, falling from 96.4% to 93.4% of normal, this week, will probably continue to decline till August. But business sentiment has perceptibly freshened as the thermometer has dropped. Commodity prices are firmer.—*The Business Week*, July 30.

Obituary

TIMOTHY HEALY, for more than a generation picturesque Irish leader of the Brotherhood of Stationary Firemen, Oilers and Railway Shop Laborers, died July 20 at Ocean Grove, N. J., of a heart attack. He was born in Limerick, Ireland, on March 25, 1883, coming to this country at the age of seventeen. Tim Healy, as he was familiarly known, was prominent in New York City politics for years, being the last Coroner New York County ever had. He was a friend of Theodore Roosevelt and campaigned ardently for him in the election of 1912. But to hundreds of thousands of American laboring men he was best known for his work in building up the Brotherhood as one of the strongest units of the American Federation of Labor.

Personals

G. JOHN GRUBER, formerly centrifugal pump engineer with the Babcock-Wilcox & Goldie-McCulloch Company of Galt, Ontario, has recently taken a position as chief designer for the Yeomans Brothers Company of Chicago.

G. KENDRICK BRINGHURST, formerly mechanical engineer for Philip H. Johnson, architect, has recently opened offices as a consulting engineer in Philadelphia.

RICHARD K. MORSE, formerly production manager of McQuay Norris Manufacturing Company of Connersville, Ind., has become associated with the Bennett Pump Corporation of Muskegon, Mich., as purchasing agent.

GEORGE H. KNUTSON, who for many years conducted a successful private practice in financial engineering, has joined the Central Public Service Corporation of Chicago as assistant vice-president in charge of the acquisition of new public utilities. Since 1922 Mr. Knutson has been active in reorganization work of utilities. He has had extensive experience in the design, construction, operation, and financing of water powers, steam plants, distribution systems, and railways.

H. D. CARLTON has resigned as president of Consolidated Ashcroft Hancock Company of Bridgeport, Conn., and as vice-president of Manning, Maxwell & Moore, Inc., of New York City.

M. L. HIBBARD, vice-president and general manager, Idaho Power Company, Boise, and last year's president of the Northwest Electric Light & Power Association, was again elected president of that organization to fill the vacancy caused by the recent death of M. W. BIRKETT of the Washington Water Power Company, Spokane, who had been elected president for the current association year. Mr. Hibbard's election occurred at a meeting of the executive committee of the association in Portland, July 18, 1930.

A. U. BRANDT, electrical engineer of the San Francisco division of the Pacific Gas & Electric Company, has been retired on pension after 31 years in service. PAUL E. CHAPMAN, who has been assistant electrical engineer under Mr. Brandt, has been appointed to fill the vacancy.

J. B. LEDLIE, since 1924 vice-president of the Mesilla Valley Electric Company, Las Cruces, N. M., has been transferred to Holdredge, Neb., where he will assume general supervision over the properties of the Western Public Service Company, these properties being situated in about 50 Nebraska towns. C. P. SPELLMAN, head of the El Paso Electric Company's statistical department, has been appointed to succeed Mr. Ledlie with the Mesilla Valley company.

Business Notes

FULLER LEHIGH COMPANY, Fullerton, Pa., announces the opening of a sales office in the Candler Building at Atlanta, Ga. J. McC. Hill is in charge of the new office.

PREST-O-LITE COMPANY, New York City, has placed in operation a new plant for the manufacture and distribution of dissolved acetylene at 648 Bryan Stock Trail, Casper, Wyo.

CUTLER-HAMMER, INC., Milwaukee, Wis., announces the acquisition of all common stock of Schweitzer & Conrad, Inc., Chicago, manufacturers of high-voltage equipment. Schweitzer & Conrad will continue to operate as an independent manufacturing and selling unit with no changes in personnel except the election as president of Beverly L. Worden, president of Cutler-Hammer. The company also announces that Walter F. Price, a member of the sales staff of Cutler-Hammer's San Francisco office, has been appointed manager of the Los Angeles branch, which includes in its territory southern California and Arizona.

A. O. SMITH CORPORATION, Milwaukee, Wis., announces the construction of a new seven-story research building, which will have adequate facilities for 1,000 scientists and engineers to carry on experimental work.

W. A. KENNEDY & COMPANY, 1100 Johnston Building, Charlotte, N. C., are now southern sales representatives for Hungerford & Terry, Inc., and the Inversand Company of Clayton, N. J.

TERRY STEAM TURBINE COMPANY, Hartford, Conn., announces the appointment of John J. Somes as manager of its Chicago office. The new location of this office is at Room 556, 20 North Wacker Drive Building, Chicago, Ill.

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, East Pittsburgh, Pa., announces that through its subsidiary, the Westinghouse Electric International Company, it has joined with a group of Spanish financial and industrial leaders in the formation of a new company, known as Constructora Nacional Maquinaria Electrica and capitalized at twelve million pesetas, to manufacture electric generators, motors, transformers, and other electrical apparatus in Spain.

GENERAL ELECTRIC COMPANY, Schenectady, N. Y., announces that sales billed for the first six months of 1930 amounted to $197,229,346.82 compared with $194,353,307.99 for the corresponding period last year. Profit available for dividends on common stock for the first six months of 1930 was $29,273,276.14 compared with $30,740,768.02 for the same six months last year, or equivalent to $1.01 per share on outstanding common stock this year and $1.07 per share for the first half of 1929.

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COMING CONVENTIONS

American Society of Mechanical Engineers. Annual meeting in New York City, Dec. 1-5. Secretary, Calvin Rice, 33 West 39th St., New York City.

American Institute of Electrical Engineers. Annual Pacific Coast convention at Portland, Ore., Sept. 2-5. District meeting at Philadelphia, Pa., Oct. 13-15. District meeting at Louisville, Ky., Nov. 19-22. Secretary, F. L. Hutchinson, 33 West 39th St., New York City.

National Association of Power Engineers. Annual convention and exhibition of power machinery at the Cleveland Auditorium, Cleveland, Ohio, Sept. 8-13. Secretary, Fred W. Raven, 417 South Dearborn St., Chicago, Ill.

National Association of Practical Refrigerating Engineers. Annual convention and exhibition at the Hotel Peabody, Memphis, Tenn., Nov. 11-14. Secretary, Edward H. Fox, 5707 West Lake St., Chicago, Ill.

National Exposition of Power and Mechanical Engineering. Grand Central Palace, New York City, Dec. 1-6. Manager, Charles F. Roth, Grand Central Palace, New York City.

Universal Craftsmen Council of Engineers. Annual convention at the Hotel Kimball, Springfield, Mass., Aug. 5-8. Secretary, T. H. Jones, 33 Linden Ave., Cherrydale, Va.

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Trade Catalogs

STEAM LINE EQUIPMENT — The American District Steam Company, North Tonawanda, N. Y., has recently issued a catalog and engineering data book (No. 30) containing complete and specialized information on the design and application of ADSCO expansion joints, steam traps, condensation and flow meters, and other products for steam distribution.

FUELS—In a 36-page, illustrated booklet, the Philfuels Company, General Motors Building, Detroit, Mich., presents a complete treatise on the history, properties and uses of liquefied natural gas for industrial purposes.

CLEANING SYSTEM—A new publication put out by the Spencer Turbine Company, Hartford, Conn., describes and illustrates a central cleaning system for use in central stations and industrial plants.

CRANES—A complete line of gas and Diesel powered locomotive cranes is described and illustrated in Booklet 309 of the Industrial Brownhoist Corporation, Cleveland, Ohio. Machines ranging from 10 to 40 tons capacity are included in the line.

COMPRESSORS—The Sullivan Machinery Company, 400 North Michigan Ave., Chicago, Ill., has just issued Catalog 83-R, describing in detail the Sullivan vibrationless portable air compressors. This 40-page, fully illustrated booklet gives complete information on the machines and their applications.

CARBON BRUSHES—"Behind the Pyramids" is the title of a 16-page illustrated booklet recently published by the National Carbon Company, Cleveland, Ohio, which tells an interesting story of the manufacture of Pyramid brushes.

GEARS—The General Electric Company, Schenectady, N. Y., has recently issued two booklets giving specifications and prices of non-metallic gears and blanks: GEA-1043A on Fabroil gears, and GEA-818A on non-metallic gears and blanks.

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Fuel Prices

COAL

The following table shows the trend of the spot steam market in various coals, f.o.b. mines; mine run, except Pittsburgh gas slack:

Bituminous (Net Tons)	At Mine, for Shipment to	Price per Ton
Navy Standard	New York	$2.10 @ $2.30
Kanawha	Cincinnati	.90 @ 1.10
Smokeless	Cincinnati	1.75 @ 2.00
Smokeless	Chicago	2.00 @ 2.25
West Kentucky	Louisville	.85 @ 1.25
Steam	Pittsburgh	1.50 @ 1.60
Gas Slack	Pittsburgh	.90 @ 1.10
Big Seam	Birmingham	1.60 @ 1.75

Anthracite (Gross Tons)	At Mine, for Shipment to	Price per Ton
Buckwheat	New York	$3.00
Barley	New York	1.15 @ 1.50

FUEL OIL

New York—July 24, f.o.b. Bayonne, N. J., 28@34 deg., Baumé, industrial use, tank-car lots, 4.75@5.25c. per gal.; f.o.b. Bayway, 36@40 deg., furnace, tank-car lots, 6@6.25c. per gal.

St. Louis—July 22, tank-car lots, f.o.b. St. Louis, 24@26 deg., $1.345 per bbl., or 42 gal.; 26@28 deg., $1.470 per bbl.; 28@30 deg., $1.570 per bbl.; 30@32 deg. $1.625 per bbl.; 32@36 deg., gas oil, 4.15c. per gal.; 38@40 deg., distillate, 4.65c. per gal.

Pittsburgh — July 22, f.o.b. local refinery, 34@36 deg., fuel oil, 3.12½c. per gal.; 36@40 deg., 3.25c.

Philadelphia—July 12, 13@19 deg., $1.05@$1.10 per bbl. or 42 gal.; 18 deg. plus, $1.475@$1.525 per bbl.; 23@27 deg., $2.00@$2.05 per bbl.

Cincinnati — July 21, tank-car lots, f.o.b. local refinery, 24@26 deg. Baumé, 5.25c. per gal.; 26@30 deg., 5.5c. per gal.; 30@32 deg., 5.75c. per gal.

Chicago—July 11, tank-car lots, f.o.b. Oklahoma, freight to Chicago, 90c. per bbl. or 42 gal.; 22@26 deg., 65c. per bbl.; 26@30 deg., 77.5c. per bbl.; 30@32 deg., $0.95 per bbl.

Boston—July 21, tank-car lots, f.o.b., 12@14 deg., Baumé, 3.33c. per gal.; 28@32 deg., 5c. per gal.

Dallas—July 19, f.o.b. local refinery 26@30 deg., $1.25 per bbl. or 42 gallons

New Plant Construction

COMPILED BY THE McGRAW-HILL BUSINESS NEWS DEPARTMENT, WHICH IS PREPARED TO FURNISH A MORE COMPLETE DAILY SERVICE TO THOSE WHO WISH IT

Conn., Terryville—Johnson Bros., Terryville Bristol, plans the construction of a dam and power house including turbine generator to supply power to residents in Greystone section, also Fall Mountain and Bucks Hill. Estimated cost to exceed $25,000.

Conn., West Hartford — Hartford Electric Light Co., 266 Pearl St., Hartford, is having plans prepared for the construction of a power sub-station at Park and Swift Sts., here. Estimated cost $40,000. W. T. Marchant, 36 Pearl St., Hartford, is engineer.

Ill., Centralia—Bd. of Local Improvements, City Hall, will receive bids until Aug. 7, for the construction of a sewage treatment plant and pumping station.

Ind., Bluffton — City is having preliminary plans prepared for the construction of a waterworks pumping station in West End. Estimated cost $15,000.

La., Morgan City—City voted $175,000 bonds for the construction of a municipal light and power plant, also improvements to waterworks and distribution systems. Swanson-McGraw, Inc., Balter Bldg., New Orleans, are engineers.

Mass., North Andover — Meadowbrook Laundry, will build a 1 story power plant including equipment. Estimated cost $40,000. H. Petzold, Bay State Bldg., Lawrence, is engineer. Work will be done by owners forces.

Mass., Taunton — Municipal Light Commission, is receiving bids for the construction of a 1 story electric sub-station and installation of underground duct lines. Estimated cost $50,000. Jackson & Moreland, Park Sq. Bldg., Boston, are engineers.

Mich., Grosse Pointe Farms— Village, J. R. Kirby, clk., will soon award contract for the construction of a water filtration plant and pumping station, etc. Hoad, Decker, Shoecraft & Druary, Ann Harbor, Mich., are engineers.

Mo., Caruthersville — City is having preliminary surveys made for the construction of a municipal light and power plant to include generating equipment, complete distribution system, etc. Estimated cost $225,000. Russell & Axon, 6200 Easton Ave., St. Louis, are engineers.

Mo., Hayti—City is having preliminary plans prepared for the construction of a municipal power plant including generating equipment, distribution system, etc. Estimated cost $80,000. Russell & Axon, 6200 Easton Ave., St. Louis, are engineers.

N. H., Dover—Twin State Gas & Electric Co., State St., Boston, Mass., will build a power transformer station, here. Estimated cost $40,000. F. W. Mason, Green St., Augusta, Me., is engineer. Work will be done by owners forces.

N. J., Jersey City — Bd. of Commissioners, G. V. O'Hanlon, Supt., City Hall, is having plans prepared for a 3 story addition to hospital including power house at Baldwin and Montgomery Sts. Estimated cost $150,000. J. T. Rowland, 30 Journal Sq., is architect.

N. J., Morris Plains—Dept. of Institutions & Agencies, State Office Bldg., Trenton, is receiving bids for furnishing and installing heating and ventilating systems in main building of New Jersey State Hospital, Greystone Park. Estimated cost $25,000.

N. Y., New York—New York Central, 466 Lexington Ave., plans the construction of a 3 story, 43 x 118 ft. sub-station at 12th Ave. and 135th St. Estimated cost $80,000, also let contract for a remote control station on Dykman St., to Aronberg-Fried Construction Co., Inc., 21 East 40th St. F. B. Freeman, is chief engineer.

O., New Boston—Ohio Power Co., 301 Cleveland Ave., awarded contract for the construction of a power sub-station at Millbrook Park to D. E. Gardner Co., Portsmouth. Estimated cost $30,000.

Pa., Ambridge — Briola Bros., 10th St., is receiving bids for the construction of a 1 story ice plant at 10th and Glenwood St. Estimated cost $60,000. Private plans.

R. I., Melville—Bureau of Yards & Docks, Navy Dept., Washington, D. C., will receive bids until Aug. 6, for the construction of power plant building, here, also power plant at Newport.

Texas—Central Power & Light Co., National Bank of Commerce Bldg., San Antonio, is having preliminary plans prepared for the construction of a hydro-electric plant at Lake Lovenskiold on Nueces River. Estimated cost $750,000. Private plans.

Texas—Irrigation District, F. S. Robertson, San Benito, is having preliminary sketches made for the construction of a power and irrigation project including ten impounding dams on Rio Grande River.

Tex., Galveston—Galveston Electric Co., 21st St. and Ave. I., plans extensions and improvements to plant to include the installation of synchronous condensers system, etc. at 26th St. and Ave. E. Estimated cost $90,000.

Tex., Rio Hondo—Rio Hondo Ice Co., c/o G. H. Fisher, Stonewall Jackson Hotel, San Benito, will build a 25 ton ice plant, here. Private plans. Work will be done by owners forces.

Tex., Schertz—U. S. Government, War Dept., A. W. Parker, Constructing Quartermaster, will receive bids until Aug. 6, for the construction of a 1 story, 180 x 280 ft. post exchange including cold storage plant, etc. at Randolph Field, here. Estimated cost $50,000. R. B. Kelly, 336 Milan Bldg., is architect. Matthews & Kenan, Smith-Young Tower, San Antonio, are engineers.

Tex., Sugarland — State Prison Commission, c/o W. A. Paddock, Chn., Second National Bank Bldg., Houston, is having plans prepared for convict farm improvements including dormitory, warehouse, new power house, electric generating plant, refrigeration plant, steam boilers, etc., here. Estimated total cost $240,000. L. D. Royer, 911 Smith-Young Tower, San Antonio, is engineer.

Utah, Heber—City voted $75,000 bonds for the construction of a municipal hydro-electric light plant. Engineer not selected.

Vt., Charlestown—Village of Barton, plans additions and alterations to municipal light and power plant. Estimated cost $40,000. I. W. Jones & Co., Milton, N. H., are engineers.

Wis., Waupon—State of Wisconsin, Madison, awarded contract for the construction of a ward building, also addition to boiler room, etc. at State Institution to W. M. Christensen Construction Co., 1419 West 6th St., Racine. $104,000.

Ont., Lucknow — City voted $70,000 bonds for the construction of a waterworks pumping plant, mains, etc. Gore, Nasmith & Storrie, Confederation Life Bldg., Toronto, are engineers.

Ont., Niagara Falls — City, S. E. Godard, Water Comr., will soon award contract for the construction of a water filtration plant and pumping station. Estimated cost $500,000.

Equipment Wanted

Engine, Generators, etc.—Pierre, S. D.—City will receive bids until Aug. 8, for power plant equipment including two Diesel oil engines each 4 cycle, air injection, 600 and 750 hp.; two electric generators of required capacity of engines, for proposed addition to power plant. Estimated cost $125,000.

Ice Manufacturing Equipment — Ambridge, Pa. — Briola Bros., 10th St., is in the market for ice manufacturing equipment for proposed new building.

Pump—Paso Robles, Calif.—City will receive new bids for furnishing and installing pump in connection with waterworks. Former bids rejected.

Pump and Motor Equipment—Rockville, Ind.—City will receive bids until Aug. 8, for pump and motor equipment for proposed waterworks improvements. Estimated cost $15,000.

Pumping Equipment—Mayfield, N. Y.—Bd. of Trustees and Water Commissioners, will receive bids until Aug. 15, for pumping equipment, etc. for proposed waterworks improvements.

Pumping Equipment—Perth Amboy, N. J.—Dept. of Public Works, plans the installation of new electric pumping equipment in connection with proposed waterworks system. Estimated cost $43,000.

Pumps—Fond du Lac, Wis. — City plans to purchase two 3 m.g. electric pumps, and one 1,400 g.p.m. deep well pump for proposed waterworks system.

Pumps, Motor, Engine, etc.—Warwick, R. I.—Water Supply Board, Town Hall, Apponaug, will receive bids until Aug. 1, for two centrifugal pumps, with 50 hp. electric motor, gasoline engine and control equipment, etc. for proposed booster pumping station.

Pumps, Motors, Air Compressor, etc.—Washington, D. C.—A. L. Flint, General Purchasing Officer of the Panama Canal, will receive bids until Aug. 6, for pumps, electric motors, air compressor, etc.

Industrial Projects

Calif., Wilmington — Los Angeles Soap Co., 617 East First St., awarded contract for the construction of a 1 story, 40 x 340 ft. factory to Griffith Co., Los Angeles Railway Bldg., Los Angeles. Estimated cost $50,000

Colo., Walden — Continental Oil Co., Continental Oil Bldg., Denver, and Dry Ice Corp. of America, 52 Vanderbilt Ave., New York, N. Y., plan the construction of a 60 ton dry ice plant, here.

Conn., Bridgeport—Heppenstall Forge Co., 95 Howard Ave., will soon award contract for the construction of a factory. Estimated cost $40,000. Fletcher-Thompson Inc., 542 Fairfield Ave., is architect.

Ind., Kokomo—Haynes Stellite Co., awarded contract for the construction of a factory on Park Ave. to C. L. Sanders & Son, Portland. Estimated cost $50,000.

Md., St. Helena—Chemical & Pigments Corp., is having plans prepared for the construction of two 50 x 110 ft. factory buildings. Private plans.

Mass., Baldwinville—Adams Paper Co., plans the construction of a paper plant. Estimated cost $50,000. Private plans.

Mass., Everett (Boston P. O.) — Merrimac Chemical Co., 148 State St., Boston, awarded contract for the construction of a sulphuric acid plant to Aberthaw Construction Co., 80 Federal St., Boston. Estimated cost to exceed $50,000.

Mich., Detroit—Bohn Aluminum & Brass Co., Joseph Campau Ave., is having plans prepared for the construction of a 1 story, 40 x 300 ft. aluminum parts factory. Estimated cost $50,000. C. W. Brandt, 1109 Francis Palms Bldg., is architect. Electric motors, etc. will be required.

Mo., St. Louis — American Car & Foundry Co., 2800 DeKalb St., plans the construction of a 1 and 2 story, 160 x 580 and 50 x 60 ft. addition to car manufacturing plant at Dorcas and Main Sts. Private plans.

N. J., Trenton—Delaval Steam Turbine Co., North Clinton Ave. and Pennsylvania R.R., awarded contract for the construction of a 1 story factory to J. W. Ferguson Co., 152 Market St., Paterson. Estimated cost $40,000.

O., Cleveland—Cleveland Trencher Co., A. V. Jones, Gen. Mgr., 20,100 St. Clair Ave., will soon award contract for a 1 story, 60 x 90 ft. addition to factory. Estimated cost $40,000. P. Schmidt, 4500 Euclid Ave., is architect.

O., Cleveland—Otis Steel Co., E. J. Kulas, Pres., 3341 Jennings Rd., is having preliminary plans prepared for a 1 story addition to rolling mill. Estimated cost $5,000,000. Private plans.

O., Cleveland—Westinghouse Electric & Mfg. Co., W. H. Freiner, Const. Mgr., West 54th St., awarded contract for the construction of a 1 story, 60 x 80 ft. galvanizing plant on West 54th St. to A. A. Lane Construction Co., 1873 East 55th St. Estimated cost $40,000.

Pa., Altoona — Keystone Armature Works, F. J. Skonier, 1814 Union Ave., will soon award contract for a 2 story, 50 x 50 ft. factory and storage building on Union Ave. Estimated cost $40,000. D. G. Puderbaugh, Myers Bldg., is architect.

Pa., Butler—American Austin Car Co., plans the construction of a body plant. Estimated cost $750,000.

Pa., Pittsburgh — Beckwith Machinery Co., Arch St. and Park Way, N. S., ("Caterpillar" tractor and equipment dealers) awarded contract for the construction of a 116 x 204 ft. factory to include warehouse, service shop, etc. at 6600 Hamilton Ave. to The Austin Co., Union Trust Bldg.

Pa., Oil City—Oil City Boiler Works, F. Ande, Purch. Agt., 351 Seneca St., awarded contract for the construction of a boiler plant to L. O. Bouquin Co., 13 East First St. Estimated cost $40,000.